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ANALYSIS OF THE STATE OF THE ART CONTINGENCY ANALYSIS MODEL (SOTACA), AIR MODULE VERIFICATION

Thesis

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THESIS

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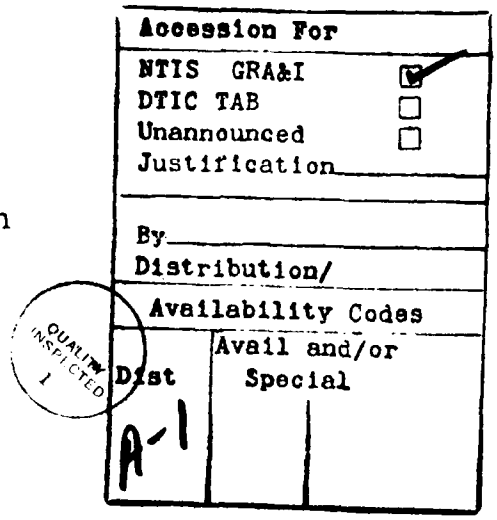

Preface

This thesis would not have been possible without the support I have received from a number of people. I would like to thank Carol Schmidt who helped me learn how to use SOTACA and who was always available to answer any new questions. The people at the Air Force Institute of Technology (AFIT) were also a great help. Without the assistance of Sharon Hsu who was responsible for getting SOTACA running at AFIT, the completion of this study would not have been possible. Dan Zambon was also a big help in getting SOTACA running and letting me use the Electrical Engineering Department's computers.

I would especially like to express my gratitude to my thesis advisors, Lt Col Schuppe and Major Garrambone. I greatly appreciated their guidance and encouragement during this effort. They kept me on track and on time.

Finally, I would like to thank my wife, Karen, for her loving support, words of encouragement, and patience throughout the last 18 months. Also, I am extremely grateful to my children, Jason and Kristen, who have been equally patient and understanding during this time. I would not have made it this far or completed my thesis had it not been for the understanding and love of my familly.

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Abstract

All computer simulation models require verification and validation if the studies conducted using these models are to have any credibility; however, in an effort to get a model up and running, or study completed, the verification and validation process is delayed and may never get done. The State of the Art Contingency Anaylst (SOTACA) Model is a good example. This paper introduces the general issue of model verification and validation and explains the current efforts done in this area on SOTACA. In addition, a methodology for verifing SOTACA's Air Module and the findings from this verification is given.

Background information on SOTACA is given to include general operation of the model, the operation and purpose of SOTACA's Air Module, and the comments and results from previous tests and reports conducted by SOTACA's users. These reports show very little previous testing has been done on SOTACA's Air Module.

The methodology used, was to build a data base, scenario, and test cases to test specific functional areas of the Air Module. The findings give problems encountered while installing, preparing the data base, and running the model. The findings indicate many of the functional areas of the Air Module have problems and the overall impression of the Air Module, is it is not reliable for studies involving air combat. In addition, other areas in the model may also be questionable. Prior to

any use of SOTACA, the documentation and verification should be improved.

The research and verification effort for SOTACA's Air Module reveals problems common to all simulation models-documentation and a credible verification and validation program. The primary recommendation from this research effort is to recommend all future models are well documented and verified for without this, the studies conducted with these models will not be credible.

ANALYSIS OF THE STATE OF THE ART CONTINGENCY ANALYSIS MODEL (SOTACA), AIR MODULE VERIFICATION

Chapter One-Introduction

General Issue

All computer simulation models require verification and validation if the studies conducted using these models are to have any credibility; however, in an effort to get a model up and running, or a study completed, the verification and validation process is delayed and may never get done [5]. The State of the Art Contingency Analyst (SOTACA) Model is a good example.

The development of SOTACA started in 1985, with the first version being released in March 1986. The basic model modeled only ground combat. In order to make SOTACA more functional, an air module was added in 1988 and a logistics module in 1989. The greatest effort was made to improve SOTACA, but as a result, very little documentation concerning the verification and validation of the model exists.

The first formal documentation of software testing was with the latest version, 3.3, released in 1989. This documentation included

the "Test and Evaluation Procedures" [16] and the "Software Test Report" [12]; however, the testing does not thoroughly test SOTACA. The following quote comes from the Software Test Report:

> Due to the time constraints imposed on the testing cycle, the only functional testing performed was that described in the SOTACA Test and Evaluation Procedures. These functional tests provided minimal coverage of the model, at best. For example, if only three test procedures exist for the air module and only one exists for the Postprocessor, the model was not thoroughly tested. [12:21]

In addition, to the lack of documented testing of SOTACA, there are several reports from users not satisfied with SOTACA's modeling of air or the documentation explaining its use and operation [3, 10.26].

The Air Module (AM) in SOTACA was added after the initial release of the model and was first included in version 3.2 which came out in August 1988. Science Applications International Corporation (SAIC) developed the AM for inclusion into SOTACA but the original version delivered to the Organization of the Joint Chiefs of Staff, Force Structure, Resources, and Assessment Directorate (OJCS/TSD) had numerous problems and did not run to OJCS/TSD's satisfaction. The OJCS/TSD corrected these problems and ran numerous tests to ensure the verification of the AM; however, OJCS/TSD did not maintain documentation due to time constraints and the priority of getting the AM into SOTACA [2].

SAIC also provided the "Analyst's Guide to Theory-the air Module" dated 5 September 1986, but this guide is incomplete due to the lack of updating the changes required to correct the AM and the changes made in the latest release of SOTACA (version 3.3).

Problem Statement

The documentation on the verification and on the operation of SOTACA's Air Module is incomplete. As a result, there is a requirement to verify the Air Module with the "Analyst's Guide to Theory-the Air Module" [14] and to clarify areas that are unclear or incomplete in the analyst's guide.

Research Objective

The objective of this thesis is to verify the major functional areas of SOTACA's Air Module and to expand the explanation of the operation of this module. To meet this objective, the following sub-objectives will be answered.

Sub-Objectives One. Ensure the nine air missions as stated in the analyst's guide are modeled correctly. This includes the following missions where:

1. Close Air Support (CAS) attacks only forces in confrontation.

2. Battlefield Air Interdiction (BAI) attacks forces within the BAI range that are not in confrontation.

3. Interdiction (IDR) attacks fixed target and forces outside of the BAI range.

4. Air Base Attack (ABA) attacks enemy airbases.

5. Battlefield Defense (BDEF) intercepts and attrits offensive air missions in theater states 3, 5, 6, 8, 9 and 11.

6. Air Base Defense (ABD) intercepts and attrits offensive air missions in theater state 6 and 8.

7. Escort, SAM, and GUN missions fly and have an effect on BDEF, ABD, and ADA forces resulting in less attrition of the primary missions. In addition, when these fractional missions are not available the primary missions do not fly.

Sub-Objectives Two. Ensure the target lists for CAS, BAI, IDR, and ABA include all possible targets and are prioritized in the correct manner.

Sub-Objectives Three. Ensure Air-to-Air, Air-to-Ground, and Ground-to-Air attrition works and appears to provide reasonable values.

Scope

The verification of SOTACA's Air Module is limited to the main functional areas discussed above, under objectives. No attempt was made to access the user interface portions (i.e. the menus and screens) of the Air Module; however, comments were made for persistent problems noted during the functional testing. Finally, due to time constraints, major problems noted with the functional areas of the Air Module were clearly identified but not explored in great detail and no attempt was made to find the cause.

Thesis Organization

Chapter One introduces the general issue of model verification and validation and explains the current efforts done in this area on

SOTACA. It also outlines the objectives required for Air Module verification of major functional areas.

Chapter Two gives the background information required to understand the Air Module's verification by covering general information and model operation of SOTACA. It also covers the Air Module's purpose and operation, and the comments and results from previous tests and reports conducted by SOTACA's users.

Chapter Three discusses the methodology used to verify the Air Module and includes the data base constructed, the scenario empolyed, and the test cases run as part of the study.

Chapter Four covers model installation problems, data base construction problems, the results from each test case presented in Chapter Three, and addresses other problem areas.

Chapter Five concludes with an overall impression of SOTACA's Air Module and ties the objectives from Chapter One with the results in Chapter Four. Additional comments are made concerning SOTACA's limitations and other items of interest found in this research. Finally, recommendations are given for further use and study of SOTACA.

Chapter Two-Background

Overview

This chapter provides the background necessary to understand the verification of SOTACA's Air Module. The two major sections in this chapter are 1) State of the Art Contingency Analysis Model and 2) Previous Testing/Reports. The first section gives general information, model uses, proponent and users, system requirements, model history, and reasons to use SOTACA. This section also covers the four phases of operating SOTACA (preprocessor, calibration, model run, and postprocessor) and discusses what the Air Module models and its operation. Finally, section one explains the model outputs, limitations, and strong points.

The second section covers previous testing on SOTACA's software and reports on the model's operation and problems. These include the Beta Test results for version 3.2, comments from the Joint Flag Officer Warfighting Course, model changes for version 3.3, and results from the Software Test Report for version 3.3.

State of the Art Contingency Analysis Model

General Information. The State of the Art Contingency Analysis (SOTACA) model is a theater level model designed to aid commanders and their staffs to rapidly evaluate alternative courses of action during crisis action planning. SOTACA is an event-driven and time stepped,

deterministic model [13:2-2]. It uses Thomas Saaty's pairwise comparisons to determine relative strengths of opposing forces and incorporates the Analysis of Military Organization Effectiveness (AMORE) methodology to determine a task force's effectiveness after confrontations. SOTACA is an interactive model, modeling ground, air, and logistics.

Model Uses. SOTACA gives the user considerable flexibility in the description of a situation allowing a wide variety of problems to be modeled that could not be done on classical models. For example, if the user wants to model a political situation, the user can define propaganda leaflets as a confronter and through SOTACA's pairwise comparisons can establish the effect of the leaflets on other confronters [13:4-20]. In addition, SOTACA's pairwise comparison can establish the relative value of a system or unit where little or no information exists[13:4-23]. Other models require some measure of performance such as a weapon effectiveness index (WEI) or weighted unit value (WUV).

SOTACA is designed for fast comparisons of alternate courses of action. It is not designed for determining a single outcome of an operation due to it's flexibility in defining confronters and subjectivity of the pairwise comparisons [20:1]. The outcome is largely determined by the way the user defines the confronters, their relative values, and the operation.

Proponent and Users. The proponent for SOTACA is shared by the Organization of the Joint Chiefs of Staff, Force Structure, Resources, and Assessment Directorate (OJCS/J-8/TSD) at the Pentagon and the Joint Warfare Center (JWC) at Hurlburt Field, Florida.

The user distribution list has 26 agencies receiving SOTACA software and documents, including all the joint commands, AFIT, Naval Postgraduate School, and several Army agencies. The agencies who have used SOTACA for studies include CENTCOM, PACOM, EUCOM, and US Army CAA. Currently, SOTACA is not being used by any agency for studies.

System Requirements. SOTACA contains over 2000 subroutines using FORTRAN 77. It will operate on VAX-11/750, 780, and 8600 series computers and the MicroVAX II or III, and requires a VMS operating system version 4.4 or higher [17:2-4]. SOTACA is currently operating at AFIT on a MicroVAX III computer (nicknamed "Raven", Electrical Engineering Department).

The graphics in the model require a Tektronix 4107/9 or 4207/9 terminal or a terminal that emulates these. In addition, the postprocessor graphics require an additional software package to operate ("Display" by Issco). If the graphics are not used, SOTACA will run using VT100 terminal. [17:2-4]

History. Science Application International Corporation (SAIC) started developing SOTACA in 1985 for the Organization of the Joint

Chiefs of staff, Force structure, Resources, and Assessment Directorate (OJCS/J-8) as part of the Modern Aids to Planning Program (MAPP). The model was designed for use by planners at both the Joint Chiefs of Staff and the Joint/Unified command levels.

SOTACA was first implemented in March 1986 [19:S-89] modeling only ground forces. In late 1986, SAIC started developing an air module and first included it in version 2.9 released in April 1987 [24]. In version 2.9, the air module was available to the user but the interaction with the ground forces was incomplete [24]. The final version of the air module was incorporated in version 3.2, released in August 1988. The latest version of SOTACA (version 3.3), released in August 1989, includes a logistics module.

In November 1989, SOTACA was put on the "shelf". The OJCS/J-8 and the Joint Warfare Center decided not to fund any more research and development because of the absence of interest in the user community [23]; however, SOTACA is still available from OJCS/J-8 for any interested user, but do not expect much support.

Reasons to Use. The user will find many facets of SOTACA that make it worthwhile to use including user friendliness, speed, and data requirements (i.e. only requires subjective valuation for weapon's systems). Since SOTACA is menu driven it does not require learning new commands to operate. The user can learn SOTACA rapidly (in about a week) using the User's Guide and going through the menus [25]; however, understanding what's going on is another matter!

The model is deterministic, so evaluating multiple courses of action can be accomplished quickly requiring only one run for each alternative. As with all models, run time depends on many factors but generally SOTACA can simulate 6-8 hours of conflict in about 10 minutes. The data base (see Appendix) used to verify the Air Module ran six hours of conflict in 2 to 3 minutes.

Finally, the data requirements for SOTACA do not require information on weapon system performance values which are hard to obtain and sometimes non-existent. Instead, SOTACA uses the users expertise to evaluate systems by making relative comparisons, one versus one, while taking the situation and environment into account [15:2]. The drawback to this methodology is it requires the user to make a lot of comparisons given a large number of battlefield systems.

> For example, for 10 confronters on each side with 2 categories of power on one side, 3 categories for the other side, and 3 mission modes, a maximum of 1065 discrete pairwise comparisons may be required.
>
> [17:5-4]

Model Operation. Use of SOTACA requires commanders/analysts to take part in "laying out SOTACA's approach to a given contingency plan and in setting up the values by which force mixes and deployment/employment plans are compared" [13:2-2]. This gives the commanders/analysts a better understanding of how the model works and the model results. The operation of SOTACA consists of four phases: Preprocessor, Calibration, Model Run, and

Postprocessor. All four phases are operated by SOTACA's menu system which prompts the user for the required inputs. [13:3-1]

Preprocessor. In the preprocessor phase, the user inputs the required data to run the model by making entries into specific fields of various screen displays representing the different data files. The data required to run the model defines the area of operations, the forces, and the scenario. The data files can be broken into four catorgies of files: area files, force files, air definition files, and logistic files.

Area Files. The area files define the area of operations and in some sense, the scenario. The major area files are the region file and the network file. The region file is a map of the area of operations which the user defines with longitude and latitude. SOTACA will then create a graphic map from the CIA World Data Bank II (WDB II). The graphic map displays international boundaries and major waterways and serves as a background for the network and the forces [17:4-15].

The network file defines the area of operations in terms of critical locations and lines of communication.

> The network is a key part of SOTACA that represents the environment within which the Joint Task Force (JTF) must operate. It is an abstract representation of the terrain, lines of communication, forces, and the locations critical to the mission of the JTF.
>
> [17:4-24]

The network is defined by nodes representing the critical locations or

objectives such as cities, sea ports, bridges, or communications centers, and by links representing the lines of communication. The links connect the nodes and are used by the task forces as they move from node to node. There are seven types of links (road, air, rail, sea, river, lake, or cross-country) and each link type has three user specified movement rates (good, fair, or poor). [17:2-23] Unfortunately, this does not allow for different units to have different movement rates. Each unit, whether an infantry or a tank unit, will move at the speed specified for the type of link they are on. To model the different movement rates, the user will need to establish parallel links between two nodes and route different units on different links [15:8].

In defining the network, the user must consider the scenario. The scenario will help decide which locations will become nodes such as a route point required for resupplies or a command post to be destroyed. The user must think through the operation and select those points which have the greatest significance to the mission [4:2-2].

Since the nodes and links are the only representation of terrain in SOTACA, the user must define these accordingly. For example, if two nodes are separated by mountains then the user must define a link length that represents the distance around the mountains or create nodes which would route the task force through a pass in the

mountains. In addition, the user-defined link speeds should represent anticipated movement rates for the terrain in the area of operations.

Force Files. The force files consist of the Available Force File (AFF), Force Planning File (FPF), and the Task Force File (TFF). There are two sets of force files, one for each opposing force. The AFF contains the major forces that will be available for long range planning in a region or command. Since most commands have areas of the world they are responsible for in case of conflict, the AFF can be built well in advance of a crisis. The structure of the AFF consists of major unit names and subordinate unit names. The names are user-defined and each major unit must have at least one subordinate unit. The subordinate units are defined by a unit type number which indicates a Unit Type Descriptor (UTD) file. The UTDs are part of the AFF and contains "information on unit composition and characteristics such as strength, weapon systems, basic load of POL, and ammunition" [17:2-3].

The Force Planning File (FPF) is a subset of the AFF and contains the forces available at the actual time of a contigency. From the FPF, the user builds the Task Force Files (TFF) for possible courses of action (COA). There can be more than one TFF made up of any combination of forces contained in the FPF, each representing a different COA. [17:2-27 thur 29]

After the force files are built, the user defines confronters, categories, and mission modes. These terms are defined below:

1. *Confronters* are the basic components which make up the force planning package and are used to accomplish the mission. Examples are riflemen, tanks, artillery, or fighter aircraft [4:3-12].

2. *Categories* are how the confronters are used. Examples are anti-tank, anti-personnel, or assault [4:3-12].

3. *Mission Modes* define what the force is doing, such as attacking or defending [4:3-12].

The possible confronters come from the weapon types in the UTDs and the user has the option to select which weapon types will be confronters [17:4-47].

Air Definition Files. The air definition files contain the data required to run the air module in SOTACA and are divided into three areas: theater, munitions and target effects, and air. The theater data is general information that applies to all air missions. This includes the relationship of the air cycle to the ground cycle, when offensive missions fly, support mission requirements, and target priorities. The munitions and target effects data includes the type of munitions required for specific targets, the number of aircraft required to deliver the weapons, and the effects the weapons have on the targets. Finally, the air data is specific information on each aircraft such as sortie rates, aircraft ranges, and munitions the aircraft are capable of carrying. The air data also includes probability of

detection and probability of kill for use in calculating air attrition. [17:4-67] (For more information see Chapter Two-Air Module, Chapter Three-Air Definition File, and the Appendix)

Logistic Files. The logistic module allows the user to model detailed logistics and requires three data files: the War Reserve Node file, the Resupply and Recovery Rate File, and the Support Force File. These data files are required only if the user activates the logistic functions they support. The War Reserve Node file contains information on resupplies and confronters available at war reserve nodes. The Resupply and Recovery Rate File contains information concerning resupply and repair requirements. Finally, the Support Force File defines the medical, maintenance, and supply forces available. Since the logistics module is new, the only documentation available is in the User's Manual (which does not explain how the logistics module works or the theory behind it). [17:2-36 thur 39]

Calibration. The calibration phase calibrates values in SOTACA to reproduce a known outcome, either from history or a higher resolution model, and establishes the power and vulnerability of confronters, attrition factors, mission decision thresholds, and FLOT movement rates. [17:2-4].

The user first determines the power and vulnerability of all confronters by making pairwise comparisons. The concept of pairwise comparisons "says that a person knowledgeable in a

particular field is quite capable of deciding whether A is preferred to B. B is preferred to A, or A and B are equal. That person can even judge how much one is better than the other" [4:3-15]. The user makes three types of pairwise comparisons: 1) power projection 2) general vulnerability, and 3) relative vulnerability. Power projection determines the relative power of confronters. The user compares confronters two at a time, in each category of employment, and in each mission mode judging which is better (more powerful) and by how much. The second comparison type determines whether A or B is more vulnerable in general and considers only the general scenario and not specific opposing confronters [13:4-35]. Finally, relative vulnerability establishes which confronter is more vulnerable when considering a power catorgy such as anti-tank. This is done for all power categories. Again, relative vulnerability does not consider specific opposing confronters, only power catorgies. [13:4-37]

SOTACA uses the power projection, general vulnerability, and relative vulnerability values of all confronters in a task force to establish a weighted power value (WPV) of the task force. When two task forces meet in confrontation, SOTACA uses the WPVs of each task force to determine a force ratio (i.e. force ratio=blue WPV/red WPV). The force ratios are used to determine mission modes, attrition, and FLOT movement rates. [13:4-39]

Model Run. During the model run, task forces move along predetermined routes and confrontation occurs when two forces meet

at a node. SOTACA examines each task force to determine where confrontations are occurring and the task forces involved. SOTACA then calculates the force ratios of the forces in confrontation to determine the mission modes. After this, the air module builds prioritized target lists for each air mission and executes these air missions. After the air missions have executed and attrited the ground forces, SOTACA recomputes the force ratios which are used for the final attrition and FLOT movement rates. [17:2-11]

SOTACA uses two types of attrition, proportional or exponential, for attriting ground forces as designated by the user [13:4-45]. The proportional attrition determines losses by multiplying the starting forces by a constant. The exponential attrition is a modification of Lanchester's linear law [20:28] and is given by the following equation:

Survivors=(Starters)exp[-(constant)(WPV)/Starters]

The constants in both the proportional and exponential attrition equations are determined during the calibration phase. [13:4-45] SOTACA is a heterogeneous model meaning it keeps track of each distinctive weapon system and displays the attrition for that system [6:5].

Postprocessor. The Postprocessor stores results from runs of different alternatives and displays these results in graphic form to allow the user to compare alternative courses of action. The user can compare data on attrition of personnel and equipment, and

expenditure of fuel, ammunition, and other supplies for both Blue and Red forces. Other displays are also available to the user. [17: 2-20]

Air Module. The Air Module (AM) in SOTACA is a separate module and executes prior to the calculations of ground attrition. The following sections will describe how SOTACA models air and the interactions with the ground forces.

Air Missions. The AM models nine air missions (see Figure 1) which can be placed into three mission types: Defensive, Offensive, and Fractional. The defensive and offensive missions are primary missions and the fractional missions are secondary missions.

Defensive
- Air Base Defense (ABD)
- Battlefield Defense (BDEF)

Offensive
- Close Air Support (CAS)
- Battlefield Air Interdiction (BAI)
- Interdiction (IDR)
- Air Base Attack (ABA)

Fractional
- Escort
- SAM
- GUN

Figure 1. SOTACA's Nine Air Missions

Defensive missions operate in response to the enemy's offensive missions and serve to attrit these forces. There are two defensive missions: Air Base Defense (ABD) which acts as a point defense over

friendly airbases, and Battlefield Defense (BDEF) which is air defense over friendly airspace [14:8-8].

The offensive missions are Close Air Support (CAS), Battlefield Air Interdiction (BAI), Interdiction (IDR), and Air Base Attack (ABA). CAS missions fly in support of friendly forces that are in confrontation. Both BAI and IDR are air actions to destroy, disrupt, delay, or neutralize enemy forces before they can engage friendly forces [14:8-7]. What differentiates BAI from IDR is the range from friendly forces. BAI missions are within 30 kilometers (can be changed by the user) of friendly forces and IDR missions are outside this range. Finally, ABA missions target enemy airbases.

The fractional missions are Escort, SAM, and GUN. These are support missions providing defense against enemy air and ground systems. The Escort missions protect friendly aircraft from the air threat. The SAM and GUN missions suppress the enemy defensive missile and artillery sites, respectively [14:8-8].

Scheduling. For SOTACA to schedule air missions, the user must specify a number of parameters. These include the following:

1. *The number of SOTACA cycles in an Air Planning Cycle* : A SOTACA cycle is a user specified time period, in hours, that the model uses to simulate ground units. The air planning cycle is the time period required for air planning, normally 24 hours. To establish the relationship between the ground and air operations, the user specifies the number of SOTACA cycles in an air planning cycle. [17:2-33]

2. *Which cycles the offensive air missions will fly* : The user specifies which ground cycles during the air planning cycle the offensive missions (CAS, BAI, IDR, and ABA) will fly. This allows the user to realistically represent air missions that do not fly 24 hours a day. For example, with 4 SOTACA cycles (6 hours each) in an air planning cycle, the user could specify cycles 2 and 3 for CAS missions representing day only missions. The defensive missions, BDEF and ABA, do not require this specification. They will fly as required to intercept the enemy's offensive missions. [17:2-33,34]

3. *Sortie Rates* : The sortie rate is the number of times each aircraft can fly during the air planning cycle. For example, if an air unit has 10 aircraft with a sortie rate of 2.5 then that unit is capable of flying 25 sorties during the an air planning cycle. SOTACA will divide the 25 sorties among the cycles the unit is flying. [17:4-93]

4. *Fractional Missions* : Fractional missions (Escort, SAM, and GUN) fly in support of the primary missions. The user must input the number of fractional missions that must accompany the primary missions. If the fractional missions are not available, the primary missions will not fly except for CAS. The fractional missions will come from the unit who is flying the primary mission if extra sorties are available. If not, SOTACA will check other units at the same base and then units at other bases. [14:8-11,12]

Theater States. Theater states represent areas where aircraft interact with various enemy air defenses [17:4-80]. They provide a

means to model attrition of friendly air, air and ground defenses, and ground targets; however, there is no direct comparison to the actual geography represented by the SOTACA network. It is assumed that all air missions will encounter some form of enemy defenses. The mission type (CAS, BAI, IDR, or ABA) dictates which theater states each mission will fly through. [14:8-12]

There are 12 theater states (see Figure 2). All missions takeoff in theater state 1 and attack their target in theater state 7. Theater states 2 through 6 represent enemy defenses encountered during ingress, while 8 through 12 represent the same defenses encountered during egress. The following is a description of each theater state [14:8-14]:

> **Theater State 1:** This state represents losses due to maintenance and will affect the current cycle. These losses will be available in the next cycle.
>
> **Theater State 2, 3, 11, and 12:** These theater states represent enemy defenses in forward battle area (vicinity of the FLOT/FEBA). Areas 2 and 12 represent the ground defenses (ADA-area defenses) encountered during ingress and egress, respectively, while 3 and 11 represnts the air defenses (BDEF) encountered during ingress and egress, respectively. CAS and BAI are the missions affected by these states.

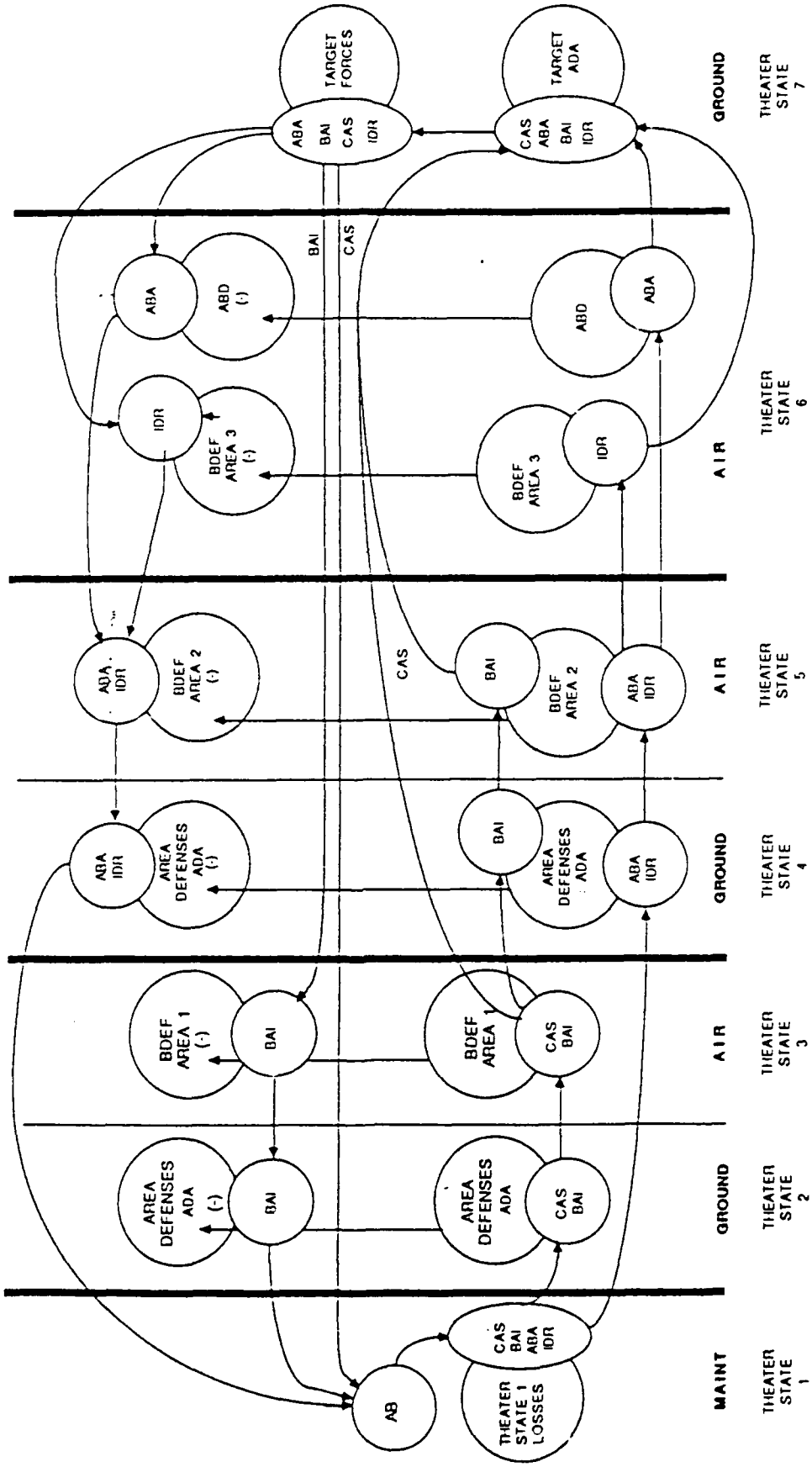

Figure 2. Theater State Interactions (17:4-80)

Theater State 4, 5, 9, and 10: These theater states represent enemy defenses between the forward battle area and the target area. Areas 4 and 10 represent the ground defenses (ADA) encountered during ingress and egress, respectively, while 5 and 9 represent the air defenses (BDEF) encountered during ingress and egress, respectively. BAI, IDR and ABA are the missions affected by these states.

Theater State 6 and 8: These theater states represent enemy air defense in the target area. Again, area 6 represents the air defenses encountered during ingress and area 8 represents air defenses on egress. IDR and ABA are the missions affected by these states, but IDR missions are intercepted by BDEF air and ABA missions are intercepted by ABD.

Theater State 7: Theater state 7 represents the target area defenses (ADA) and all missions are vulnerable to these forces. In addition, the targets (either fixed point or enemy forces) are attacked and attrited by the air forces.

The user supplies probability of detection and probability of kill for air-to-air, air-to-ground, and ground-to-air interactions which governs the attrition factors for each state. The attrition factors apply to both the primary and fractional sorties as they pass through each

theater state. Survivors continue to their target, deliver their ordnance, and return to their base [14:8-15].

Targeting. SOTACA allows the user to establish target priorities for CAS, BAI and IDR missions. CAS targets are any enemy forces engaged with friendly forces. SOTACA will present the user with a list of possible CAS targets and the user can prioritize the targets from highest to lowest, designate targets not to be attacked, or give equal priority to all targets. If the last option is chosen, SOTACA will prioritize targets according to force ratio, from highest to lowest or lowest to highest (user's choice) [17:4-74].

BAI targets are forces within the BAI range as declared by the user (30km is the default). With BAI targets, the user has the same options as with the CAS targets. For the automatic prioritization, SOTACA will select targets closest to the friendly forces first. [17:4-76]

Finally, IDR targets are forces or nodes (except airbases) outside the BAI range. For an unoccupied node to be a target, it must be inside enemy airspace. The IDR target list will only have one entry mark "task forces", representing all forces, along with multiple node targets. The "task forces" entry can be prioritized along with the other IDR targets. Targets not prioritized will not be attacked. Once the "task forces" are prioritized among the other IDR targets, the task forces can be prioritized among themselves, similar to the BAI targets. [17:4-77]

ABA missions do not have a user selected prioritization option. SOTACA prioritizes these targets based on the number of sorties generated during the last cycle [14:8-31].

Munitions and Target Effects. The munitions and target effects menu allows the user to specify different munitions and their effects. The user must also specify which aircraft carry which loads and the number of sorties required to attack different type targets. This information is used to degrade targets in the SOTACA network during model runs [14:8-21].

Execution. The AM is executed at the beginning of each SOTACA cycle before the ground confrontations take place and after the force ratios have been calculated [14:8-33]. The force ratios are used to aid in allocating sorties to targets. The AM creates target lists for each of the primary missions as discussed above. These lists are checked to determine [14:8-35]:

1) The preferred munition.

2) The air unit with this mission and its capability to carry the preferred munition.

3) If sorties are available.

4) If the target is within range.

5) If there are fractional sorties available.

If the above criteria is met then the target is selected for attack.

After the final target lists are created, SOTACA executes the AM. During execution, attrition is calculated for all air units and for the

nodes and forces attacked. The forces remaining after the AM is executed, are the forces available to fight the ground battles. [14:8-33]

Output. The primary output parameters the user has available for evaluation of COAs are force attrition, movement rates, and expenditures of fuel and ammunition. The user gets this output data from SOTACA after the model run and postprocessor phases. After each cycle during the model run, the user can select various force summary displays to review the current status of forces. These displays will give information for the current cycle or cumulative results for all the cycles. For comparison of multiple COAs, the postprocessor will collect data from runs of each COA and present the results in user-defined graphs and charts. The information available to the user is identical to the output data in the model run phase, except the information is consolidated from all the runs into graphs and charts.

Model Strong Points. SOTACA has several strong points that make it worth using including: flexibility, speed, and model set-up. SOTACA's pairwise comparisons and network system provide the analyst with a great deal of flexibility in defining an operation. It allows the user to define confronters which may not be weapons and give values to these confronters. It also allows the use of the analyst expertise for defining the worth of confronters.

Secondly, SOTACA can simulate 6-8 hours of combat in about 10 minutes allowing the user to evaluate several COAs in a short amount of time.

Finally, SOTACA's greatest strength is the insight it gives to the analyst during model setup. In defining the network and confronters the analyst must think through the entire operation and the objectives. SOTACA's menu driven system aids the analyst in this thought process.

Previous Testing/Reports

The documentation of test and evaluation on SOTACA has been limited. This section will cover results from three reports on version 3.2, changes to version 3.3 from 3.2, and software test results on version 3.3. The first report concerns the results of the Beta Tests on SOTACA, Version 3.2, performed by US Central Command. The next two reports come from the Army War College and the Air Force Wargaming Center concerning problems encountered with SOTACA, Version 3.2, during the Joint Flag Officer Warfighting Course held January through February 1989. Finally, the changes concerning the Air Module for version 3.3, come from the "Version Description Document" and results from testing version 3.3 come from the "Software Test Report for SOTACA Version 3.3".

Beta Test Results for SOTACA Version 3.2. The Beta Test was a test of SOTACA's Version 3.2 prior to the official release of Version

3.2 and was performed at U.S. Central Command (CENTCOM), Macdill AFB, Florida [8]. The comments concern the use of fractional missions and attrition results. The results are summarized below.

CENTCOM reported problems with the use of fractional missions in SOTACA. They could not get BAI, IDR, and ABA missions to fly without all fractional missions (Escort, SAM, GUN) and stated

> There is currently a requirement for a primary mission to include fractional missions-escort, SAM, and Gun. It is unrealistic in that a primary mission will not fly unless it has a set of all fractional missions (by design). This requires the user to enter unrealistically high priorities for the fractional missions.
>
> [8:5]

CENTCOM also looked at the air attrition and recommended the incorporation of air killer-victim tables (air-to-air, air-to-ground and ground-to-air) to aid the analysis of air attrition. Without these tables, CENTCOM was unable to verify the air attrition methodology. Version 3.3 has partially corrected this problem with the addition of an air-to-ground killer-victim table. [8:2]

The results reported concerning air-to-air attrition indicated possible problems concerning the attrition methodologies and CENTCOM recommended the air attrition methodologies be analyzed. They found the attrition losses were less than expected. With probabilities of kill (Pks) equal to1.0 for both the Blue and Red, attrition was less than 100%. Also losses for both Blue and Red were about equal even though Red flew three times the sorties Blue flew. Table 1 summarizes the results. [8:B-2]

The results for ground-to-air attrition also showed possible errors in attrition methodology. They found low Pks caused losses to be higher then expected (see Table 2).

Pk	Blue Kill/Fly	Red Kill/fly
.1	2/12	2/36
.2	3/12	3/36
.3	5/12	5/36
.4	6/12	7/36
.5	7/12	8/36
.6	8/12	10/36
.8	10/12	13/36
.9	11/12	14/36
1.0	11/12	16/36

Table 1. Air-to-Air Attrition Caused by ABD and BDEF Missions (Pds=1.0) [8:B-2]

Pk	Blue Kill/Fly	Red Kill/fly
.1	8/12	18/36
.2	11/12	29/36
.3	12/12	34/36
.4	12/12	36/36

Table 2. Ground-to-Air Attrition to CAS Missions [8:B-2]

Other results reported by CENTCOM include the following:

1. CAS missions flew but did not appear to affect ground attrition other than air defense confronters [8:B-1].

2. IDR missions flew and attrited ground forces but changes in air-to-ground probability of kill only affect air defense confronters [8:B-1].

3. ABA missions flew but CENTCOM did not understand how the attrition data was calculated [8:B-1].

4. ABD sorties did attrit ABA missions [8:B-1].

CENTCOM's biggest criticism in the Beta Test was the lack of documantation to explain the operation of the Air Module. Without this documentation they were unable to understand or explain the results from the Beta Test. They stated

> Overall documentation of the Air Module should be improved. A 'how-to' guide should be prepared for the analyst to explain the steps required to properly operate the Air Module. In addition, Analyst Guide documentation is needed so that the analyst can understand the Air Module algorithms.
>
> [8:1]

The Use of SOTACA at the Joint Flag Officer Warfighting Course. SOTACA was used for wargaming at the Joint Flag Officer Warfighting Course held at Maxwell AFB, Alabama on Jan/Feb 89. Both the Army War College and the Air Force Wargaming Center reported on SOTACA's use. The following lists the major problems each agency encountered:

SOURCE: Army War College [10]

a. The Air module needs an analyst guide to theory.

b. The Air Module lacks the ability to discreetly target or restrict a target.

c. The air attrition appeared to be higher then expected.

d. In the air module, sortie generation is limited to 1 sortie/cycle so if a long cycle length is used (i.e. 48 hours) the number of air sorties is low.

e. Nodes can not be targeted unless a task force is on the node so attacking a node to close a link is not possible.

f. The air apportionment does not work correctly (The air apportionment tells SOTACA what percentage of your sorties are to be flown as CAS, BAI, IDR, etc.).

g. SOTACA will not allow the user to fly air interdiction missions.

SOURCE: Air Force Wargaming Center [26]

a. The air module can not discreetly select or selectively restrict targets.

b. The air module cycle length can not be less than the SOTACA cycle length. This creates problems with the number of aircraft sorties that can be flown.

c. Aircraft can only be used to target ground forces designed as air defense units.

d. Aircraft can not attack nodes for the purpose of causing delays and disruptions of ground forces.

Model Changes to Version 3.3. The Air module problems reported above occurred in SOTACA Version 3.2. In August 1989, Version 3.3 was released. This new version incorporated a logistics module into SOTACA and made minor changes to the Air Module. The changes made to the Air Module are shown below:

1. Air Vulnerability Calibration was changed to add capability to calibrate vulnerability on non-deployed ground confronters to air attack, using the logic behind general vulnerability calibration so non-depoyed confronters will be vulnerable to air attack [18:3-3].

2. Read-Only from Run-Time Air Data removes the CHANGE and SAVE options from the first three air menus during run-time to allow access to these menus [18:3-6].

3. Air Killer/Victim Attrition Results Screen was added to give air-to-ground killer/victim tables [18:3-7].

4. The Fixed Target Munitions Load and Effects Screen went from two screens to one [18:3-7].

5. CAS Target Priority Doctrine Option was modified so program won't crash when D(octrine) key is pushed [18:3-8].

6. Air Module Munitions Load Pointers were corrected so attrition results would be correct [18:3-8].

7. The Air Module did not test to determine if the IDR target is a node or a task force so a test was added to stop the task force priority array from being searched when the IDR target is a node [18:3-9].

Software Test Report for SOTACA Version 3.3. Starting with SOTACA Version 3.3, the Organization of the Joint Chiefs of staff, Force structure, Resources, and Assessment Directorate (OJCS/J-8) initiated two documents: 1) SOTACA Test and Evaluation Procedures and 2) SOTACA Software Test Report. Prior to Version 3.3, OJCS/J-8 had no formal verification program to ensure the computer code operated correctly [23]. The Test and Evaluation Procedures outlines procedures "to verify both that the model's user interface works smoothly and that the major functional elements of the model are working properly" [16:1-1] and the Software Test Report gives the results from these tests [12:1].

The Software Test Report gives results of the functional testing of the ground module, the air module, the postprocessor, and the logistics module and results of testing of the user interface portion of SOTACA (the user interface consists of approximately 600 screens) [12:1]. This report only had three functional tests for the Air Module and the Air Module passed all three tests with no major problems. The results of these functional tests are given below:

Test 1: The Air Targeting Test[12:7]
Purpose: This tests if AM correctly handles targeting and air mission scheduling [16:4-38].

Results: Test passed with one problem generated [12:7, 17]. The problem was minor and concerned the model requesting the Air Killer-Victim report when there was no information in it [12:A-91].

Test 2: Air Mission Assignment [12:8]
Purpose: This tests to see if aircraft range is taken into account for air missions [16:4-40].
Results: Test passed, no problems generated [12:8, 18].

Test 3: Air Node Readiness [12:8]
Purpose: This tests the effects of node readiness on flying air missions [16:4-42].
Results: Test passed, no problems generated [12:8, 18].

One of the recommendations of the Software Test Report was to add more functional tests to each area in SOTACA being tested. The Air Module was specifically addressed. "Air module verification testing needs to be increased. Only three tests were provided for the entire section" [12:22].

Chapter Summary

This chapter covered the background information required to understand the Air Module's verification by covering general information and model operation of SOTACA. It also covers the Air Module's purpose and operation, and the comments and results from previous testing and reports conducted by SOTACA's users.

The next chapter discusses the verification methodology used to verify the Air Module and includes the data base construction, the scenario, and the test cases.

Chapter Three-Methodology

Overall Approach

Chapter Three gives the overall approach used to verify SOTACA's Air Module (AM). Model verification will ensure the computerized model matches the conceptual model. The methodology used for the AM model verification consists of the following stages: 1) Research the operation of SOTACA and the AM, 2) Build test cases, 3) Isolate specific inputs and outputs, 4) Run the model, and 5) Repeat stages 2 and 3 as necessary. Chapter Two discussed the results from the research of the model operation and describes what the AM was intended to model. This chapter covers the data base and scenario required for the test cases and the test cases used to verify the AM.

Data Base

SOTACA comes with a data base that includes both the ground and air forces and can be loaded and run by calling for case study "Pracex_3". Pracex_3 was not used to verify the AM because there are too many interactions between the input variables and it did not lend itself to isolating one input in order to observe the results and to verify specific AM opertion. Therefore, "Airtest", a data base which could meet these objectives, was built. In order to run the AM, the following files are required: Regional, Network, Available Force, Force Planning, Confronter Definition, Task Force, Air Definition, and Decision

Threshold. These files are discussed below and a complete listing is given in the Appendix.

Regional File. The Regional File contains data on the area of the world where the military operation is occuring [17:2-22]. SOTACA uses this information as a background for the network (nodes and arcs). For the purpose of AM verification, any region will work. The region used was central Europe.

Network File. The Network File contains the critical locations (nodes) and lines of communication (links) in the area of operation [17:2-23]. In order to place forces in the network at locations (nodes) where they would be attacked by a specific air mission and to simplify the determination of enemy airspace, the network created was a checkerboard or grid pattern (see Figure 3). There are a total of 25 nodes, equally spaced and all nodes are designated as bridges except nodes 1 and 25 which are air bases and nodes 5 and 21 which are command centers. Node designation is used to determine the air mission attacking it (IDR or ABA) and the priority of the target node.

Available Force File (AFF). The AFF, Table 3, defines major units that might be available for a contingency [17: 2-24]. The major units are composed of subordinate units which are defined by a unit type descriptor (UTD). The UTD contains the specifics of each subordinate unit (i.e. number of personnel, support vehicles, weapon systems; basic loads of fuel, ammunition, and supplies; and information used by AMORE). "TYPE" refers to the UTD and "QTY" refers to the number

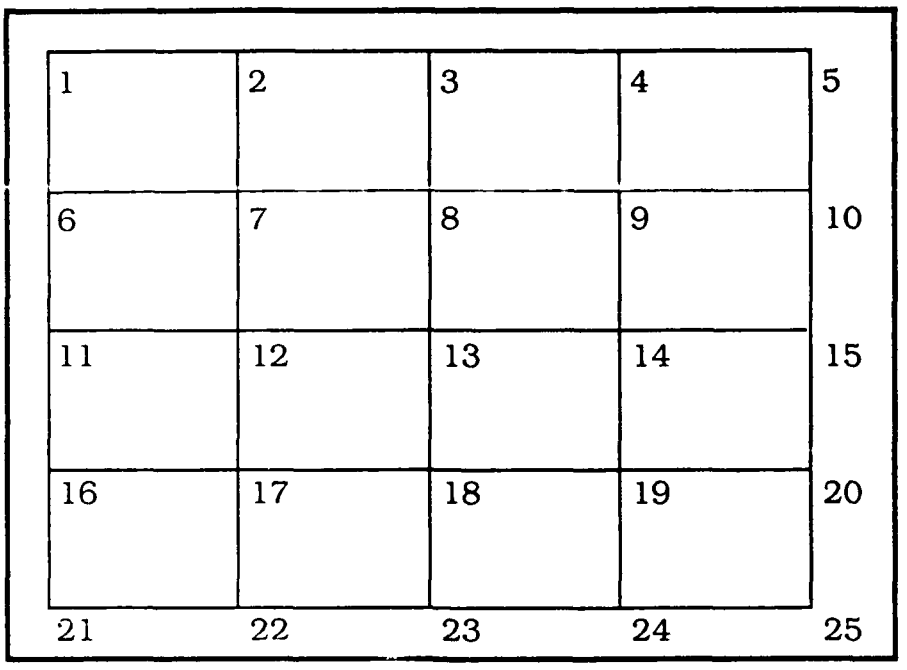

Figure 3. Network

Table 3. Available Force File Display [1]

A F F S T R U C T U R E (Available Forces File)	BLUE TYPE	QTY
MAJOR UNIT HEADINGS		
SUBORDINATE UNIT HEADINGS		
**********		
Blue Motorized Rifle Regiment		
Blue Headqtrs	1	1
Blue Rifle Bat	2	4
Blue Tank Bat	3	4
Blue How Bat	4	4
Blue Anti-air	5	4
Blue Air Wing		
F-15 ABD	101	1
F-15 Escort	102	1
F-16 BDEF	103	1
F-16 BAI	104	1
F-111A IDR	105	1
F-111D ABA	106	1
A-10 CAS	107	1
F-4 SAM/GUN	108	1
Blue Air Headquarters		
Headqtrs	6	1

of this type unit available. The AFF for both the Blue and Red forces are identical in "Airtest". Since the opposing forces are identical, results for both sides should also be identical. This provides another check to verify the operation of the AM. The complete listing of the Blue and Red AFFs and UTDs for Airtest is in the Appendix.

Force Planning File (FPF). The FPF is a file of the forces selected from the AFF that will be available when the contingency operation takes place. The FPF for Airtest is identical to the AFF (see Appendix).

Task Force File (TFF). The TFF contains subordinate units from the FPF. The subordinate units can be taken from their major unit and placed in specific task forces for employment into the contingency area of operation. Once placed into a task force, the subordinate units can not be separated and will travel through SOTACA's network as a single enity. The Airtest data base uses five task forces for Blue and five for Red, consisting of identical force compositions. both being identical. The task forces are Blue or Red Hdqts, Blue or Red Air, Blue or Red I, Blue or Red II, and Blue or Red III with task forces I, II, and III containing identical ground forces/equipment (see Table 4).

The TFF also contains information on the task force's initial location and movement route through the network. Figure 4 shows locations of all the task forces in the network for the AM verification.

Table 4. Task Force File Display [1]

```
T F F   S T R U C T U R E   BLUE
     (Task Force File)
                                    Q
Task Force Heading                  T
  UNIT Headings                     Y
**********************************
B Hqtrs
  Blue Headqtrs                     1
  Blue Rifle Bat                    1
  Blue Tank Bat                     1
  Blue How Bat                      1
  Blue Anti-air                     1
B I
  Blue Rifle Bat                    1
  Blue Tank Bat                     1
  Blue How Bat                      1
  Blue Anti-air                     1
B II
  Blue Rifle Bat                    1
  Blue Tank Bat                     1
  Blue How Bat                      1
  Blue Anti-air                     1
B III
  Blue Rifle Bat                    1
  Blue Tank Bat                     1
  Blue How Bat                      1
  Blue Anti-air                     1
B Air
  Headqtrs                          1
  F-15 ABD                          1
  F-15 Escort                       1
  F-16 BDEF                         1
  F-16 BAI                          1
  F-111A IDR                        1
  F-111D ABA                        1
  A-10 CAS                          1
  F-4 SAM/GUN                       1
```

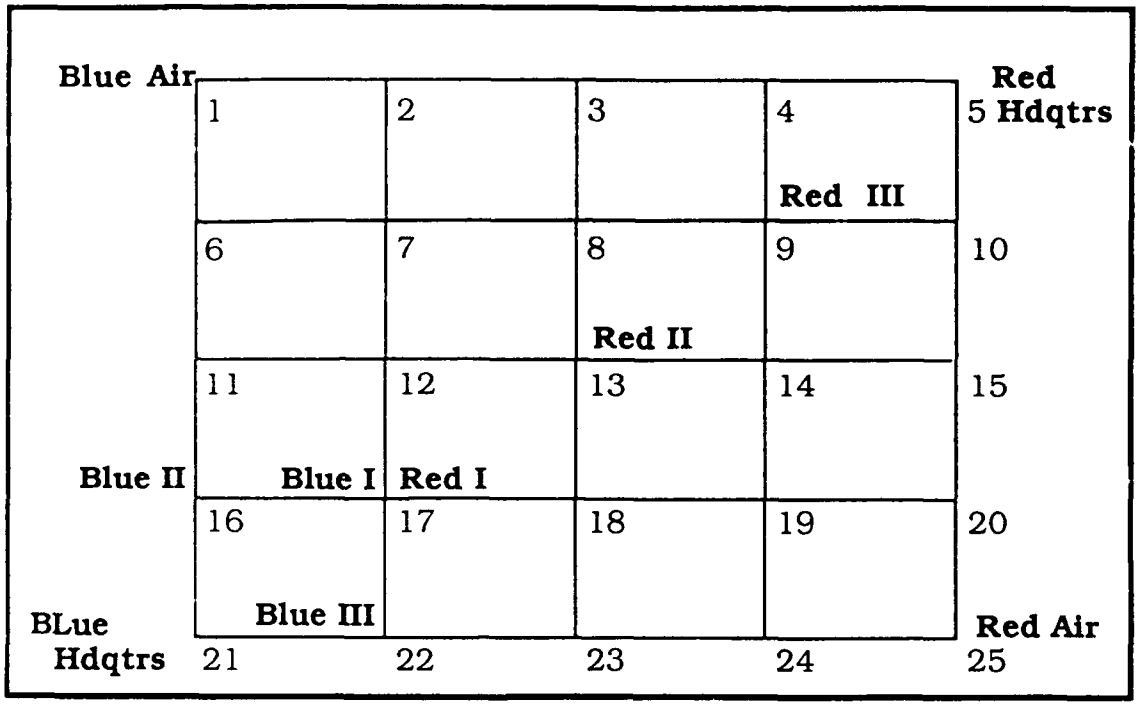

Figure 4. Task Force Placement in the Network

Confronter Definition File (CDF). The CDF contains the information needed to specify the confronters (weapons or anything else capable of projecting power) and includes confronter labels, power and vulnerability values, power category labels, and mission mode labels [17:2-30]. All power and vulnerability values are the same making all ground confronters equally vulnerable and equally powerful. The attrition from ground confronters is set to zero so these values will not affect the attrition loses. The Airtest power category label and mission mode label are "anti-force" and "attack", respectively. Only one power category and one mission mode is used to simplify the Airtest data base. These labels are user defined and should convey the

type of power and the mode of operation the user intends the confronter to use. For example, "anti-force" is used here to indicate the Blue (or Red) confronters will be used to oppose enemy forces.

Confronter labels are also user defined and should convey the type of weapon the user is representing. Table 5 shows the Blue

Table 5. Confronter Definition Data Display [1]

BLUE	WEAPON TYPE	TOTAL FPF QUANTITY	CONFRONTER TITLE	A CONF-A DEF DESIGNATION
	PERSONNEL	5380	PERSONNEL	
	SUPPRT VEH	745	SUPPRT VEH	
	PLATOONS	134	PLATOONS	
	AT1	600	LT WEAPONS	
	AT2	688	HV WEAPONS	
	APC	511	APC	
	IFV	0		
	TANK1	160	TANK	
	TANK2	0		
	LACV	0		
	LT_ARTY	0		
	H_ARTY	0		
	AA OPTICAL	120	IR SAM	AD
	AA RADAR	50	RADAR SAM	AD
	ATK HELO 1	0		
	ATK HELO 2	0		
	ATK HELO 3	0		
	MISC 1	0		
	MISC 2	0		
	MISC 3	0		
	MISC 4	0		
	MISC 5	0		
	FIGHTER 1	30	F-15 ABD	AC
	FIGHTER 2	30	F-15 Escor	AC
	FIGHTER 3	30	F-16 BDEF	AC
	FIGHTER 4	30	F-16 BAI	AC
	FIGHTER 5	30	F-111A IDR	AC
	FIGHTER 6	30	F-111D ABA	AC
	ATTACK 1	30	A-10 CAS	AC
	ATTACK 2	30	F-4 SAM/GU	AC
	ATTACK 3	0		
	ATTACK 4	0		

confronter definition display. This display gives totals of all Blue (or Red) weapon types contained in each force's UTDs. The user must supply confronter titles (labels) in order for a confronter to project power. "A CONF-A DEF DESIGNATION" in Table 5 designates particular confronters as air defense (AD) systems or air confronters (AC). These confronters will then be used by the SOTACA to run AM. The CDFs for Airtest are in the Appendix.

Attrition Data File (ATT). The ATT contains information on the attrition mode (exponential or proportional) and the survival rate, "SURV-RATE", for ground confronters only (see Table 6). SOTACA uses the survival rate as a multiplier of the initial strength to determine the number of survivors at the end of the cycle. SOTACA

Table 6. Attrition Data Display [1]

BLUE CONFRONTERS	INITIAL STRENGTH	6.0 HOUR SURVIVORS	ATTRITION MODE	6.0 HOUR SURV-RATE	EXPONENTIAL COEFFICIENT
PERSONNEL	5380	5380	E	1.0000	0.0000
SUPPRT VEH	745	745	E	1.0000	0.0000
PLATOONS	134	134	E	1.0000	0.0000
LT WEAPONS	600	600	E	1.0000	0.0000
HV WEAPONS	688	688	E	1.0000	0.0000
APC	511	511	E	1.0000	0.0000
TANK	160	160	E	1.0000	0.0000
IR SAM	120	120	E	1.0000	0.0000
RADAR SAM	50	50	E	1.0000	0.0000
F-15 ABD	30	30	E	1.0000	0.0000
F-15 Escor	30	30	E	1.0000	0.0000
F-16 BDEF	30	30	E	1.0000	0.0000
F-16 BAI	30	30	E	1.0000	0.0000
F-111A IDR	30	30	E	1.0000	0.0000
F-111D ABA	30	30	E	1.0000	0.0000
A-10 CAS	30	30	E	1.0000	0.0000
F-4 SAM/GU	30	30	E	1.0000	0.0000

then calculates an exponential coefficient from the end-of-cycle survivors. The survival rate is set at 1.0, so no ground attrition occurs and all attrition can be attributed to the air module. Table 6 shows the Blue attrition data display for Airtest. The Red ATT is the same.

Air Definition File (ADF). The ADF provides the parameters for SOTACA's air environment and is divided into three data sets: 1) Theater Data is general and applies to all air missions; 2) Munitions and Target Effects Data determines the number of sorties, the munition type, and the munition effects against specific targets; and 3) Air Data is specific to aircraft type such as aircraft range and probability of detection and kill of other aircraft [17]. The entire listing of the ADF can be found in the Appendix. The major parameters used in the Air Module verification are described below.

Theater Data. The Air Mission Scheduling Display is used to set the BAI range and the cycles the primary offensive missions (CAS, BAI, IDR, and ABA) fly. Within the BAI range, targets are allocated to BAI and outside this range the targets are allocated to IDR. The default for BAI range is 30km and is used in Airtest. The primary offensive missions are set to fly during all cycles for the Blue forces and are set not to fly at all for the Red forces. Since the defense missions (BDEF and ABD) will fly in response to the enemy's offensive missions, Red BDEF and ABD will fly and air-to-air attrition can be observed. In addition, the ground attrition should only occur to Red forces since Blue forces are the only offensive missions flying.[17:4-69]

The Air Apportionment Order sets the distribution of sorties to missions [17:4-70]. All missions are set to 12% except for the Escort and SAM/GUN missions which are set to 14%.

The Fractional Mission Requirements sets the number of support or fractional mission aircraft that must accompany the offensive missions [17:4-72]. The term "fractional" is used because the data entry represents a fraction of the offensive missions flown. For example, if the BAI fractional mission requirement is 0.20 and 20 BAI sorties are flying, then 4 fractional missions are required (20 X 0.20). The fractional mission requirements are set to 0.10 for all Blue air missions. The settings for Red air are not used since no Red offensive air is flying.

The Target Priority Menu allows the user to set target priorities and to limit the number of targets of any offensive air mission [17:4-72]. Airtest uses SOTACA's defaults for all force targets (see Chapter Two). In IDR missions, force targets and fixed targets must be prioritized and the priority is "force targets", "Bridges" (stationary or fixed), and "Command Control Sites" (stationary or fixed).

The Target List Limits for CAS, BAI, IDR, and ABA can be "N" for no targets attacked, "Y" for all targets attacked (if assets are available), or a number to indicate the maximum number of targets of that type attacked [17:4-79]. For Airtest, the target list limits are initially set to "N" in order to ensure no air kills occur when air missions do not fly.

The data files for target priorities and target list limits are in the Appendix.

Munitions and Target Effects Data. The munitions and target effects data entry requires the number of sorties, the munitions load, and the munitions effects. For both fixed and force targets, number of sorties is ten, the munitions load is bombs, and the effect is 0.25. Airtest uses a ten sortie requirement per target due to the small number targets in Airtest and the desire to get a reasonable number of sorties flying to observe attrition effects. With a ten sortie requirement, 20 to 30 offensive air sorties flew per cycle.

Air Data. The Air Data menu allows the user to set sortie rates, probability of detection (Pd), and probability of kill (Pk). Sortie rates are set to 6.0 to ensure the maximum number of sorties flew and all probabilities are set to zero. The probabilities are set to zero to ensure no attrition takes place initially. The probabilities are then selectively changed to values other then zero to isolate specific portions of the AM (see Test Cases the end of this chapter).

Decision Threshold File (DTF). The DTF contains data that determines what mission mode task forces use when in confrontation and when the task force should withdraw from battle. Airtest was made as simple as possible so there is only one mission mode, attack. The threshold to withdraw is set at 0.2 to ensure forces stay in confrontation long enough to evaluate Air Module results.

Scenario

There are many different definitions of scenario and ideas of what a scenario contains [22:299]. Some analysts would include the scenario as part of the data base definition [5]; however, for SOTACA's Air Module verification, the scenario refers only to how the task forces are initially positioned and their movement routes. The scenario developed through three phases: 1) Both the Blue and Red Forces moving, 2) Red Forces only moving, and 3) neither force moving.

Initially, the Blue forces started at node 21 (Blue Headquarters) and the Red forces started at node 5 (Red Headquarters), and both forces moved to a confrontation at node 13 with the task forces I, II, and III leaving at six hour intervals. There were two problems with this scenario: 1) It took several cycles to get all air missions flying and 2) the eligible targets for any air mission changed each cycle making it difficult to isolate each air mission's area of responsibility.

The second scenario positioned Blue Task Force I at node 17, Task Force II at node 16, and Task Force III at node 22 and the Blue forces remained stationary. The Red Task Forces all started at node 5 and moved to Blue Task Force I at node 17. This scenario had similar problems as the first scenario had.

Finally, the Blue and Red Task Forces were located at the nodes shown in Figure 6 and remained stationary. This scenario provided air results after the first cycle and was the scenario used to verify the Air Module. In addition, a clear definition of the air mission's area of

responsibilities remained unchanged throughout all cycles with the exception of a BAI target changing to a CAS target in the second cycle. The sequence of events in SOTACA is first to determine the offensive air targets and then to start the cycle. Blue Force I and Red Force I are both on node 17 but confrontation does not start until the cycle starts so during target determination these forces are not in confrontation. As a result Red Force I is a BAI target during the first cycle and a CAS target for all other cycles.

Test Cases

The three test cases used to verify the Air Module (AM) are the Null Case (ground forces only), the Base Case (both ground and air forces), and the Attrition Case (increased air forces). The Base Case has six variations and the Attrition Case has two variations. All test cases were run for two cycles to collect output data from all air missions. The second cycle is required to get results from CAS missions.

The results of the runs come from two sources: summaries that are available from menu options and are listed in the User's Manual [17]; and summaries that are available by selecting hidden option 33 from the Model Run Control Menu or the Force Status Display Menu [24]. These hidden options are used in debugging SOTACA and are not listed the User's Manual. They are available only through

printouts. The following summaries give the results reported in Chapter 4:

1. *Task Force Strength Summary* gives total losses from both ground and air confronters.

2. *Ground Killer-Victim Tables* give kills to ground confronters from specific ground confronters.

3. *Air Summary* gives sorties flown and aircraft losses.

4. *Air Killer-Victim Tables* give kills to ground confronters from specific air missions.

5. *Node Readiness Summary (hidden option)* gives the node readiness for all nodes. A one indicates fully ready and a zero indicates no readiness [2].

6. *Target Lists (hidden option)* gives the targets for each air mission listed in order of priority [2].

7. *Killer-Victim Scoreboard (hidden option)* gives kills to ground confronters from specific air confronters [2].

8. *Air Attrition of Major Task Forces (hidden option)* gives kills to ground confronters from all air missions [2].

Null Case (ground forces only). The Null Case contains no air forces-i.e. no Air Unit Type Descriptors and no Air Definition file. The null case is intended to show no ground attrition will occur from the ground forces with the current Attrition Data File. Following each run, the Task Force Strength Summary, Ground Killer-Victim Tables, and the Air Killer-Victim Tables will be checked for losses.

Base Case (both ground and air forces). The Base Case contains the necessary files to run both the ground and air modules and serves as a basic data base for running the six variations below.

Variation One-Air Does Not Fly. Variaton One will be run with no changes to the basic data base so no air missions will fly. This will confirm the Air Module will not effect ground forces if air missions do not fly. These results will be confirmed from the Task Force Strength Summary, Ground Killer-Victim Tables, the Air Summary, and the Air Killer-Victim Tables.

Variation Two-Air Flies. Variation Two will be run after changing the Target List Limits for Blue offensive air missions to "Y". This variation will fly the Blue offensive air (CAS, BAI, IDR, and ABA) and the Red defensive air (BDEF and ABD) and will test the basic operation of the Air Module. The offensive missions will be checked to see if each mission is attacking and attriting targets in their area of responsibility and the target lists will be checked to ensure all possible targets are included and are in the correct order of priority. These results will be obtained from the Task Force Strength Summary, Ground Killer-Victim Tables, the Air Summary, and the Air Killer-Victim Tables; and from printouts of the Node Readiness Summary, Target Lists, Killer-victim Scoreboard, and the Air Attrition of Major Task Forces.

Variation Three-Munitions Effects/Degradation Factors. Variation Three varies both fixed and force target munitions degradation factors from 0.25 to 1.00 in increments of 0.25. The results will be used to determine if the degradation factor is used as a straight multiplier to obtain node readiness and attrition outputs. The

results will be obtained from the Task Force Strength Summary, Ground Killer-Victim Tables, the Air Summary, and the Air Killer-Victim Tables; and from printouts of the Node Readiness Summary.

Variation Four-Fixed/Force Target Adjustment Factors. The Fixed target adjustment factor is used to determine incidental attrition to forces when fixed targets are attacked and the Force target adjustment factor is used to determine incidental attrition to fixed targets when forces are attacked. Variation Four tests the effects the the adjustment factors have on incidental attrition. Both factors are set to 1.0 and are used by the AM to multiply the respective degradation factor (fixed or force) to obtain the incidental degradation. The fixed and force degradation factors are set to 0.25 so the incidental attrition should also be 0.25. The results will be obtained from the Task Force Strength Summary, Ground Killer-Victim Tables, the Air Summary, and the Air Killer-Victim Tables; and from printouts of the Node Readiness Summary.

Variation Five-Fractional Missions. SOTACA allows the user to request fractional missions to support the offensive air missions. Fractional mission support for all offensive air missions will be varied from 0.0 to 0.5 in increments of 0.1 to determine the effect on the number of offensive missions flown and to verify the effect fractional missions have on air attrition. The results will be obtained from the Air Summary and the Air Killer-Victim Tables.

Variation Six-Apportionment. Variation Six will test the effect the Air Apportionment order has on the number of missions flown. Selected air missions will be set to zero apportionment to verify the AM does not apportion sorties to these missions. Results will be confirmed from the Air Summary.

Attrition Case (increased air forces). The Attrition Case is identical to the Base Case except the number of each type of air confronter is increase from 30 to 60. The Attrition Case tests the effects different Probability of Detection (Pd) and Kill (Pk) have on attrition. Only Pds and Pks addressed have values other then zero. The other Pds and Pks are left at zero so results can be isolated to a specific Pd or Pk.

Air-to-Air Attrition. The air-to-air attrition is tested by varying the air-to-air Pds and Pks and checking the results from the Air Summary. The first test (Runs 1 through 4) checks that the air-to-air attrition works and seems reasonable. The inputs are varied from one extreme to the other. Four combinations of Pds and Pks are used and are summarized in Table 7.

Table 7. Pds and Pks for Red ABD vs Blue F-111D ABA (Test Runs 1 through 4)

Run Number	1	2	3	4
Pd=	0.0	0.1	1.0	1.0
Pk=	1.0	1.0	1.0	0.1

The next test (Runs 5 through 8) verifies the use and effect of fractional missions against ABD and BDEF missions. If the fractional missions actually help the offensive missions then the losses to Blue offensive missions should be reduced with fractional missions. To verify this, Run 5 gives Red ABD the capability to detect and kill all Blue air missions while Blue has no capability against Red. Run 6 then gives Blue Escort missions an equal capability against Red ABD. Runs 7 and 8 are similar to 5 and 6, respectively, but Red BDEF is used in place of Red ABD. Table 8 summarizes the inputs for these runs.

Table 8. Pds and Pks for Red ABD vs Blue F-111D ABA
(Test Runs 5 through 6)

Run Number:	**5**	**6**	**7**	**8**
Red ABD vs All Blue Aircraft				
Pd=	**1.0**	**1.0**	0.0	0.0
Pk=	**1.0**	**1.0**	0.0	0.0
Blue F-15 Escort vs ABD				
Pd=	0.0	**1.0**	0.0	**1.0**
Pk=	0.0	**1.0**	0.0	**1.0**
Red BDEF vs All Blue Aircraft				
Pd=	0.0	0.0	**1.0**	**1.0**
Pk=	0.0	0.0	**1.0**	**1.0**
Blue F-15 Escort vs BDEF				
Pd=	0.0	0.0	0.0	**1.0**
Pk=	0.0	0.0	0.0	**1.0**

The final test (Run 9) of air-to-air attrition tests the effects non-fractional missions have against BDEF missions. Run 9 is run with the Pd and Pk of Blue BAI against Red BDEF aircraft both set at 1.0. Red

aircraft losses from the Air Summary will verify the effects of the Blue BAI missions.

Ground-to-Air Attrition. The ground-to-air attrition will be tested by giving the two air defense confronters, Red IR SAMs and Red Radar SAMs, the capability to detect and kill (Pd=1.0 and Pk=1.0) all Blue aircraft. The results will come from the Air Summary and will be checked to ensure the air defense confronters effect the air confronters.

Chapter Summary

Chapter Three discussed the verification methodology used to verify the Air Module and includes the data base construction ('Airtest"), the scenario, and the test cases used for this verification.

The next chapter covers model installation and data base construction problems, and gives the results from each test case presented in this chapter.

Chapter Four-Results

Overview

Chapter Four gives the results from running the case studies developed in Chapter Three. All case studies ran on a Micro Vax III (Vax 3600) using SOTACA version 3.3 with the AMORE estimator turned off. All results come from the first cycle of the case study unless otherwise specified. The run time (refers to a single cycle) for all runs was between two to three minutes with data collection taking 20 to 30 minutes. The case studies discussed below are the Null Case, the Base Cases, and the Attrition Cases. Prior to this discusion, the problems associated with getting SOTACA running at the Air Force Institute of Technology and building a data base from scratch are covered. The final section of this chapter covers problems evident throughout all the test cases.

Model Installation

SOTACA requires a VMS operating system version 4.4 or higher and is written in Fortran 77 [17:2-4]. The User's Manual also states "SOTACA code is transportable only to DEC/VAX computers" [17:2-4]. The first attempt to get SOTACA on an AFIT computer system was tried on the ELXSI 6400 system using an EMS operating system which is a VMS emulator. SOTACA was unable to run on the ELXSI because

the EMS system library could not support subroutine calls made by SOTACA [7].

The second attempt to get SOTACA on an AFIT computer system was tried on a Micro Vax III using a VMS, version 5.1, operating system. This required minor modifications to SOTACA's COM file to set the directory pointers, but SOTACA was up and running [7], and fully operational with one exception. SOTACA's Postprocessor requires vendor-supplied graphics [17:2-4]. The vendor-supplied graphics are "Display" which is written by ISSCO [23] and is not available on any systems at AFIT. The only limitation to operating SOTACA without the Post-processor is data between runs is not automatically collected and put into a single graphic displays showing differences between runs. The user can still collect output data at the end of each run.

Problems Encountered in Building the Data Base

Users will encounter three problems when trying to create a new data base in SOTACA, version 3.3: 1) SOTACA will not let the user change the cycle time (accessing the Calibration Time Interval Select/Change menu causes the program to dump during model run); 2) When creating a new Air Definition File (ADF), SOTACA will not allow the user to save the ADF under most of the save options; and 3) SOTACA will not allow the user to access the Fixed Target Munition Loads/Effects Menu unless data for munition effects already exists.

The first problem occurs anytime the user enters the Attrition Calibration Menu and selects option 3, Calibration Time Interval Select/Change. This option controls the time interval (the default is six hours) SOTACA uses to calibrate attrition data with the confrontation cycle [17:5-28]. The user can enter this menu and make cycle time changes, but during the model run, the program will "crash". Since this menu made SOTACA unusable, all test cases used to verify the Air Module used the default time cycle of six hours.

The second problem occurs when the user creates a new Air Definition File (ADF) and tries to saves it. There are a total 18 menus used to enter information into the ADF and each menu has a save option. The save option works if an ADF exists and the user is changing information; however, if the user is saving the ADF for the first time, the save option will not work. There is one save option that will save a new ADF and is located in the Munitions Load Titles menu. This menu is the 9th menu the user will come to if he is creating the ADF in the order the menus occur.

The final problem occurs when the user tries to access the Fixed Target Munition Loads/Effects Menu. When creating a new ADF, no values exist in this menu and SOTACA will give the user a warning message stating "Munition Loads must first be entered" [1]. SOTACA is telling the user to enter values but will not allow access to the menu where this can be done. This problem is a result of changes made to SOTACA for version 3.3. In SOTACA version 3.2, there were two

menus, 1) Fixed Target Munition Loads and 2) Fixed Target Effects [17:4-85, 86] which were combined into the Munitions Loads/Effects Menu for version 3.3 [18:3-7]. This problem has also been identified in SOTACA's Software Test Report [12:A-37]. The user can work around this problem by quitting SOTACA, going directly to the ADF data file, using an editor to put these values in the file, and reloading the ADF in SOTACA.

The Null Case (Ground Forces Only)

Purpose. The null case was run to ensure results obtained from other test cases were not due in any part to ground confrontations and to confirm the attrition from other ground confronters is zero.

Results. The Null Case ran two cycles with the Task Force Strength Summaries and the Air Killer-Victim Tables for both Blue and Red forces being checked at the end of each cycle. The Task Force Strength Summaries showed no losses for both Blue and Red forces and the Air Killer-Victim Tables give messages stating there were no Blue or Red air kills.

Observations. The Ground Killer-Victim Tables for both Blue and Red forces also confirmed no losses for any ground confronters when reviewing the "totals" for each confronter; however, losses for "Personnel" and "Hv Weapons" from the killers "Platoons", "Lt Weapons", "Hv Weapons", "APC", and "Tank" confronters showed 6, 29, 33, 24, 8 kills, respectively, but the total kills were zero (see Table 9).

These identical values were present in the ground killer-victim tables for all the cases run; however, these values did not appear to be included in any of the kills reported elsewhere in the model.

Table 9. Killer-Victim Display [1]

KILLER-VICTIM TABLE H = HELP

TABLE TYPE: CURRENT PERCENTAGE NODE: ALL NODES OF ENGAGEMENT

UNIT NAME: All Blue Forces In Country

RED KILLER CONFRONTERS	BLUE VICTIM CONFRONTERS: PERSONNEL	SUPPRT VEH	PLATOONS	LT WEAPONS	HV WEAPONS	APC	TANK	IR SAM	RADAR SAM
PERSONNEL	0	0	0	0	0	0	0	0	0
SUPPRT VEH	0	0	0	0	0	0	0	0	0
PLATOONS	6	0	0	0	6	0	0	0	0
LT WEAPONS	29	0	0	0	29	0	0	0	0
HV WEAPONS	33	0	0	0	33	0	0	0	0
APC	24	0	0	0	24	0	0	0	0
TANK	8	0	0	0	8	0	0	0	0
IR SAM	0	0	0	0	0	0	0	0	0
RADAR SAM	0	0	0	0	0	0	0	0	0
TOTAL KILLD	0	0	0	0	0	0	0	0	0

The Base Case (Both Air and Ground Forces)

Purpose. The Base Case was used to verify the Air Module (AM) would fly all the air missions specified in the User's Manual [17] and the Analysis Guide [14], and to provide a base case for comparison as variables in the Air Definition File were changed. Several different variations of this case were used.

Results

Variation One-Air Does Not Fly. Although the Base Case included all the necessary files and definitions to use the AM, it ran

first without any air units flying. The Target List Limits for both Blue and Red CAS, BAI, IDR, and ABA were set to "N" to indicate "no" missions of these types were to be flown. As in the Null Case, the Base Case ran two cycles with the Task Force Strength Summaries and the Air Summaries for both Blue and Red forces being checked at the end of each cycle. The results were identical to the Null Case with the Task Force Strength Summaries showing no losses for both Blue and Red forces and the Air Killer-Victim Tables giving messages stating there were no Blue or Red air kills; however, when reviewing the Air Mission Status Report, BDEF and ABD missions for both sides had flown 30 missions each (all other missions had flown zero). This is inconsistent with the users manual which states "the defensive missions, BDEF and ABD, will operate in response to the enemy's offensive missions" [17:4-69], and there were no offensive missions due to the settings of the Target List Limits.

Variation Two-Air Flies. In variation two, the Target List Limits for Blue CAS, BAI, IDR, and ABA were changed to "Y" to indicate all possible targets in these categories on the opposing side may be hit. Initially, variation two was intended to confirm all air missions flew and to provide a data base to compare results from other test cases; however, this variation also provided verification of a good portion of the AM's missions and targeting priorities. In particular, variation two verified the following:

(Note: The "target lists" and the "node readiness summary" mentioned below are not screen displays but will be printed by selecting hidden option 33 then option 2 and/or option 6, respectively, before starting the first or current cycle [2].)

1. The Blue CAS missions only attacked and attrited the Red forces that were in confrontation. This was confirmed from the target lists which showed no Blue CAS targets for cycle one and one CAS target for cycle two, the Red Task Force I. The Red Task Force I is the only Red task force in confrontation and was not on the CAS target list for the first cycle due to the order the model is executed. The target lists are formed before the cycle starts so even though the Blue Task Force I and the Red Task Force I are on the same node, the confrontations do not start until the cycle does. The CAS air-to-ground killer-victim tables also confirmed the only CAS losses occured to the Red Task Force I.

2. The BAI missions only attacked and attrited forces not in confrontation and within the BAI range set. The target lists verified the only Blue BAI targets were the following: 1) Cycle One-Red Task Forces I and II. 2) Cycle Two-Red Task Forces II. The Red Task Force I was on the BAI list for cycle one because it was not in confrontation until cycle one started. The BAI air-to-ground killer-victim tables also confirmed the only BAI losses occured to the Red Task Force I and II during cycle one and to the Red Task Force II during cycle two.

3. The IDR missions attacked only nodes and forces outside the BAI range. The target lists for both cycle one and two verified the

only Blue IDR fixed targets were nodes 5, 9, 10, 14, 19, and 20 and the only Blue force targets were the Red Task Force III and the Red Headquarters. The fixed target effects were confirmed from the node readiness summary which showed node 9 to have a readiness of 0.75 (1.0 reflects full readiness). The remaining nodes on the IDR target list were not attacked due to an insufficient number of IDR sorties. The force target effects were confirmed from the IDR air-to-ground killer-victim tables which showed the only IDR losses were to the Red Task Force III and the Red Headquarters.

4. The ABA missions attacked only the enemy air bases. The target lists for both cycle one and two verified the only Blue ABA target was node 25, the Red Air Base and the node readiness summary showed node 25 to have a readiness of 0.5 after the attack. In addition, during cycle two the number of Red BDEF and ABD missions were decreased by the node readiness verifying ABA missions will result in a decrease in the ability of the Red Air Base to fly missions.

5. The target lists for CAS, BAI, IDR, and ABA included all the forces and/or nodes for the respective target list and all targets were in the correct order of priority. This was confirmed from the target lists printed by selecting hidden option 33 then option 2 prior to cycle run. These target lists are summarized in Table 10.

Table 10. Blue CAS, BAI, IDR, and ABA Target Lists.
(Target lists are in order of priority-high to low)

Cycle One			
CAS	BAI	IDR	ABA
	Red I	Red III	Node 25
	Red II	Red Hdqtrs	
		Node 9	
		Node 10	
		Node 14	
		Node 19	
		Node 20	
		Node 5	
Cycle Two			
CAS	BAI	IDR	ABA
Red I	Red II	Red III	Node 25
		Red Hdqtrs	
		Node 9	
		Node 10	
		Node 14	
		Node 19	
		Node 20	
		Node 5	

In addition to verifying the above items, verification was attempted on the following, but the results indicated incorrect operation:

1. The BDEF and ABD missions did not fly in response to the enemy's offensive missions as stated in the User's Manual [17:4-69] and the Air Analysis Guide [14:8-9] but flew regardless of missions being flown by the opposing side. This was confirmed from the Air Mission Status Report showing 30 Blue BDEF and 30 Blue ABD missions flying without any of the Red Offensive missions flying.

2. The attrition figures in the Task Force Strength Summary tables do not match the Air-to-Ground Killer-Victim tables. The Air-to

Ground Killer-Victim tables give the kills due to the air confronters only. The Task Force Strength Summary tables give kills from both ground and air confronters, but the attrition factors for ground confronters are set at 0, so attrition occurs only from the air confronters and both these tables should be identical. Table 11 shows the attrition of all the Red Task Forces during cycles one and two.

The difference between the attrition in the Task Force Strength Summary tables and the Air-to-Ground Killer-Victim tables could be due to rounding errors that occur when the model calculates individual units losses and then aggregates these losses to determine total losses for each task force; however, the differences are large enough to cause concern in the user. In addition, the attrition losses from the Killer-Victim Scoreboard and the Air Attrition of Major Task Forces are identical to the those reported in the Task Force Strength Summary tables, which indicates the Air-to-Ground Killer-Victim tables are probably in error. Both these tables are not available from screen displays but will be printed by selecting the hidden option 33 and then selecting option 7 for the Killer-Victim Scoreboard and/or option 4 for the Air Attrition of Major Task Forces prior to starting the initial or current cycle.

Table 11. Red Attrition Summaries
(Under losses the first number comes from the Task Force Strength Summary tables and the second number comes from the Air-to-Ground Killer-Victim tables)

Attrition Summary-Red Hdqtrs

Confronters	Starting Strength	Cycle 1 Losses	Cycle 2 Losses
Personnel	1180	33, 30	32, 30
Support Veh	160	4, 2	5, 2
Platoons	35	1, 0	1, 0
Lt Weapons	150	4, 4	4, 4
Hv Weapons	172	5, 4	4, 4
APC	130	4, 3	3, 3
Tank	40	1, 1	1, 1
IR SAM	30	1,0	1,0
Radar SAM	10	0, 0	1, 0

Attrition Summary-Red I

Confronters	Starting Strength	Cycle 1 Losses	Cycle 2 Losses
Personnel	1100	60, 58	57, 55
Support Veh	150	8, 6	8, 5
Platoons	33	2, 0	2, 0
Lt Weapons	150	8, 8	8, 7
Hv Weapons	172	9, 8	9, 8
APC	127	7, 6	7, 6
Tank	40	2, 2	2, 2
IR SAM	30	2, 1	1, 1
Radar SAM	10	1, 0	0, 0

Attrition Summary-Red II

Confronters	Starting Strength	Cycle 1 Losses	Cycle 2 Losses
Personnel	1100	31, 28	58, 56
Support Veh	150	4, 2	8, 5
Platoons	33	1, 0	2, 0
Lt Weapons	150	4, 4	8, 7
Hv Weapons	172	5, 4	9, 8
APC	127	4, 3	6,6
Tank	40	1, 1	2, 2
IR SAM	30	1, 0	1, 1
Radar SAM	10	0, 0	1, 0

Attrition Summary-Red III

Confronters	Starting Strength	Cycle 1 Losses	Cycle 2 Losses
Personnel	1100	31, 28	29, 28
Support Veh	150	4, 2	4, 2
Platoons	33	1, 0	1, 0
Lt Weapons	150	4, 4	4, 4
Hv Weapons	172	5, 4	4, 4
APC	127	4, 3	3, 3
Tank	40	1, 1	1, 1
IR SAM	30	1, 0	1, 0
Radar SAM	10	0, 0	1, 0

Attrition Summary-Red Air

Confronters	Starting Strength	Cycle 1 Losses	Cycle 2 Losses
Personnel	900	0, 0	0, 0
Support Veh	135	0, 0	0, 0
Radar SAM	10	0, 0	0, 0
ABD	30	0, 0	0, 0
Escort	30	0, 0	0, 0
BDEF	30	0, 0	0, 0
BAI	30	0, 0	0, 0
IDR	30	0, 0	0, 0
ABA	30	0, 0	0, 0
CAS	30	0, 0	0, 0
SAM/GUN	30	0, 0	0, 0

Attrition Summary-All Red Forces

Confronters	Starting Strength	Cycle 1 Losses	Cycle 2 Losses
Personnel	5380	154, 144	177, 169
Support Veh	745	21, 12	24, 14
Platoons	134	5, 0	5, 0
Lt Weapons	600	21, 20	24, 22
Hv Weapons	688	24, 20	27, 24
APC	511	18, 15	20, 18
Tank	160	6, 5	6, 6
IR SAM	120	4, 1	5, 2
Radar SAM	50	1, 0	2, 0

Variation Three-Munitions Effects/Degradation Factors.

SOTACA allows the user to change munitions effects for both fixed targets and force targets by entering a degradation factor. The degradation factor is specfic to the munitions being used and the target being attacked. Neither the User's Manual [17] or the Air Analyst's Guide [14] explain what the degradation factor actually means in terms of the actual effect on node readiness or attrition. Table 12 shows the results for both fixed and force targets due to the degradation factors being varied from 0.25 to 1.00 in increments of 0.25. The node readiness dropped by the same amount, indicating that for fixed targets the degradation factor is used as a straight multiplier to determine the node readiness. This was not the same result for force targets. Table 12 shows the increase in attrition losses for personnel as the degradation factors were varied from 0.25 to 1.00. The attrition losses increased linearly as the degradation

Table 12. Fixed/Force Target Effects.

Degradation Factor	0.25	0.50	0.75	1.00
Fix Target:				
Node Readiness	0.75	0.50	0.25	0.00
Percent Lost	25%	50%	75%	100%
Force Target (Personnel):				
Starting Strength	5380	5380	5380	5380
Losses	154	307	457	606
Percent Lost	2.9%	5.7%	8.5%	11.3%

factors increased linearly, but the percentage lost was only about 10%

of the degradation factor. These results were similar for all the confronters in the task force.

Variation Four-Fixed/Force Target Adjustment Factors. Both the fixed and force target adjustment factors were set to 1.0. The results verified the force target adjustment factor had an effect on incidental attrition to nodes. The nodes where forces were attacked showed a 25% decrease in node readiness.

The results also showed the fixed target adjustment factor had no effect on incidental attrition to forces. No attrition occurred to ground forces at the ABA targets and no additional attrition occurred at IDR targeted nodes (some attrition occurred due to the force at this node being an IDR targeted force).

Variation Five-Fractional Missions. In variation four, the requirement for fraction mission support was varied to test the effects on the primary missions. The following is a list of results:

1. If the fraction mission support is set at 0, all primary missions will fly normally. This result is contrary to the general interpretation of the users. The User's Manual states:

> A zero or blank field means that the fractional mission is not required by the specified primary mission. CAS is the only primary mission that may be executed without the required fractional mission support. All other primary missions will be aborted if the required fractional support cannot be satisfied.
>
> [17:4-72]

The users have interpreted this statement to mean fractional missions must be specified and available for BAI, IDR, and ABA missions to fly.

The following is a quote from a memorandum from CENTCOM to J-8:

> There is currently a requirement for a primary mission to include fractional missions-escort, SAM, and GUN. It is unrealistic in that a primary mission will not fly unless it has a set of all fractional missions (by design). This requires the user to enter unrealistically high priorities for the fractional missions.
>
> [8:5]

This is an incorrect interpretation. SOTACA does not require fractional missions unless the user specifies a value other then zero. If fractional missions are specified by the user then SOTACA will require fractional missions before allowing BAI, IDR, and ABA missions to fly.

2. When fractional mission support was required for CAS, BAI, IDR, and ABA but was not available, CAS was the only mission to fly all their scheduled missions. Table 13 shows the effect fractional mission requirements have on CAS, BAI, IDR, and ABA.

There were 30 Escort and 30 SAM/GUN missions available to support these missions, but the full 30 missions never flew. In an attempt to get all 30 fractional missions to fly, fractional mission requirements were all set to zero except for BAI missions which were set at 1.0. Again, only 66% of the fraction mission flew (see Table 14). In addition, during cycle 2 when CAS missions started flying, the percentage of fractional missions flying dropped to 33%. Both cycles should have given identical results.

Finally, fractional mission requirements were all set to zero except for BAI and IDR missions which were both set at 1.0. These results also indicate the Air Module's use of fractional mission requirements

Table 13. Effects from changing Fractional Mission Requirements For All Missions

Cycle One	Fractional Mission Requirement*				
Mission	0.1	0.2	0.3	0.4	0.5
CAS	0	0	0	0	0
BAI	30	30	30	30	**20**
IDR	30	30	30	30	30
ABA	20	20	20	**10**	**10**
Escort	6	12	18	20	15
SAM/GUN	6	12	18	20	15
Percentage of Fractional Missions to Primary Missions:	8%	15%	22%	28%	25%

Cycle Two	Fractional Mission Requirement*				
Mission	0.1	0.2	0.3	0.4	0.5
CAS	20	20	20	20	20
BAI	20	20	20	**10**	**10**
IDR	30	30	30	30	30
ABA	20	20	20	**10**	**10**
Escort	6	12	18	20	16
SAM/GUN	6	12	18	20	16
Percentage of Fractional Missions to Primary Missions:	7%	10%	13%	23%	40%**

*The fractional mission requirements were the same for all missions.

**The SOTACA simulation gave a message that CAS would be flying without fractional mission support.

Table 14. Effects of Fractional Mission Requirements For BAI Missions

Fractional Mission Requirements Set at 1.0 for BAI		
Mission	Cycle 1	Cycle 2
CAS	0	**20**
BAI	30	**20**
IDR	30	30
ABA	20	20
Escort	20	10
Sam/GUN	20	10
Percentage of Fractional Missions to Primary Missions:	66%	50%

is incorrect. During the first cycle BAI and IDR missions flew even though no fractional missions flew. When CAS support missions started flying during the second cycle, both the number of BAI and IDR missions changed and fractional missions started flying. CAS had no requirement for fractional missions and should not have affected BAI, IDR, Escort, or SAM/GUN missions. These results are summarized in Table 15.

Table 15. Effects of Fractional Mission Requirements For IDR and BAI Missions

Fractional Mission Requirements Set at 1.0 for BAI, 1.0 for IDR		
Mission	Cycle 1	Cycle 2
CAS	0	**20**
BAI	20	**10**
IDR	10	**20**
ABA	20	20
Escort	**0**	10
Sam/GUN	**0**	10
Percentage of Fractional Missions to Primary Missions:	0%	33%

Variation Six-Apportionment. The base case was run with apportionment set to zero for specific air missions. The results verified the use of apportionment; The air mission set to zero will not fly.

The Attrition Test Case (Increase Air Forces)

The attrition test case tests the effects of varying probability of kill (Pk) and probability of detection (Pd) between air-to-air and ground-to

air confronters. All Pks and Pds are set to zero unless specifically addressed.

Results

Air-to-Air. Table 16 shows the results of varying the Pd and Pk of Red ABD against the Blue F-111D ABA. These results are similiar to the results in the Beta Test to SOTACA Version 3.2 [8:B-2] and indicate the attrition methodology may be in error. In particular, when Red Air's Pd and Pk are 1.0, Red has a number advantage on Blue (3 to 2), and Blue Air's Pd and Pk are 0, Blue only losses 14 aircraft (only one more loss from when Red's Pd was 0.1).

Table 16 also shows that Pk has a greater effect then Pd. When Pk was set at 0.1 with Pd at 1.0 losses went to 4.

Table 16. Losses to Blue F-111D ABA aircraft from Red ABD (**20** F-111D ABA Aircraft Flown and **30** Red ABD Aircraft Flown)

Red ABD Vs.	Pd=	**0.0**	**0.1**	**1.0**	**1.0**
Blue F-111D ABA	Pk=	**1.0**	**1.0**	**1.0**	**0.1**
		Lost	Lost	Lost	Lost
F-111D ABA		**0**	**13**	**14**	**4**

Table 17 shows the effects Red ABD missions have on Blue Air. The results verify ABD missions only affect ABA aircraft and their fractional missions and the fractional missions have an effect on Red Air when given a capability to detect and kill Red ABD aircraft. When the Blue F-15 Escort is given a capability to detect and kill Red ABD aircraft, the Blue losses decrease as expected; however, this also

results in fewer Red ABD missions being flown. The Blue F-15 Escort capability to detect and kill Red ABD aircraft should not affect the Red BDEF and ABD sorties. The results also show an error in the attrition methodology which allows more Red Kills (42) then Red missions flown (37). The effects of Red BDEF (Table 18) are similar to Table 17.

Finally, when Blue BAI aircraft's Pd and Pk are equal to 1.0 (all other Blue Pds and Pks are 0) against Red BDEF aircraft, the Red BDEF aircraft lose no aircraft. This result indicates the Air Module will not allow aircraft to kill enemy aircraft unless their mission is Escort.

Table 17. Losses to Blue and Red Aircraft with Pd=**1.0** and Pk=**1.0** for Red **ABD** Missions Against All Blue Air Missions

	Pd=**0** and Pk=**0** for Blue F-15 Escort Vs. Red ABD		Pd=**1.0** and Pk=**1.0** for Blue F-15 Escort Vs. Red ABD	
Blue	Flown	Lost	Flown	Lost
A-10 CAS	0	0	0	0
F-16 BAI	60	0	60	0
F-111A IDR	60	0	60	0
F-111D ABA	60	**26**	60	**12**
F-16 BDEF	60	0	60	0
F-15 ABA	60	0	60	0
F-15 Escort*	30	**14**	30	**8**
F-4 SAM/GUN*	30	**14**	30	**8**
Red				
BDEF	60	0	60	0
ABD	60	0	**37**	**41**

*All fractional missions support ABA aircraft.

Table 18. Losses to Blue and Red Aircraft with Pd=**1.0** and Pk=**1.0** for Red **BDEF** Missions Against All Blue Air Missions

	Pd=**0** and Pk=**0** for Blue F-15 Escort Vs. Red ABD and BDEF		Pd=**1.0** and Pk=**1.0** for Blue F-15 Escort Vs. Red ABD and BDEF	
Blue	Flown	Lost	Flown	Lost
A-10 CAS	0	0	0	0
F-16 BAI	60	**25**	60	**22**
F-111A IDR	60	**22**	60	**18**
F-111D ABA	60	**7**	60	**1**
F-16 BDEF	60	0	60	0
F-15 ABA	60	0	60	0
F-15 Escort*	30	**3**	30	**0**
F-4 SAM/GUN*	30	**3**	30	**0**
Red				
BDEF	60	0	**52**	**13**
ABD	60	0	**37**	**42**

*All fractional missions support ABA aircraft.

Ground-to-Air. When the ground Air Defense confronters were given a capability to detect and kill Air Confronter, no air losses occured. The Pds and Pks for Red IR and Radar SAMs were set to 1.0 against all Blue air confronters. The first run was made with the width, depth, and HIMAD Range of the Air Defense Belt set to 1Km. In the second run, the width, depth, and HIMAD Range of the Air Defense Belt was set to 20Km. In both cases, Blue Air losses were 0.

Results Evident Throughout All Tests

AMORE Estimator. With the AMORE estimator off, task force effectiveness is reported as the percentage of confronters left after a cycle. Currently, SOTACA reports this value as zero until the first ground confrontation occurs. If the task force is attrited by Air, this

attrition is not reported until after the first ground confrontation occurs. This is incorrect and this display should start reporting unit effectiveness as soon as attrition occurs whether it is due to ground or air forces.

In addition, The Aggregate Summary Display for all Blue (or Red) Forces contains a column headed "non-effective assets". With the AMORE estimator off, this column does not apply and all values should be zero; however, for "Support Veh" all support vehicles were reported under the non-effective assets column.

Air-to-Ground Killer-Victim Tables. Two problems were noted on the Air-to-Ground Killer-Victim Tables: 1) the "P"age option is inoperative and 2) the cumulative values were not being reset to zero when starting the initial cycle.

Sortie Rates. The sortie rates did not generate the number of sorties exected. This was confirmed from the Air Mission Status Report. The number of sorties per cycle is calculated by taking the "Sortie Rate (6)" multiplying by the "Number of Aircraft (30)" and dividing by "Number of Cycles (4)" [14:8-34] which should have resulted in 45 sorties being flown, but only 30 sorties flew. The sortie rates were set at 6.0. This was also noted in a memorandum from the Air Force Wargaming Center [26:2].

An additional run was made with the attrition test case using sortie rates set at 4.0 for all missions. All missions except BDEF and ABD flew all aircraft available. The results for BDEF and ABD are

summarized in Table 19. During each subsequent cycle the number of sorties decreased by 25%, until cycle 5 (the start of a new Air Planning Cycle) where the number of sorties returned to 60. There is nothing in SOTACA's documentation to explain these results.

Table 19. BDEF and ABD Sorties Flown (60 BDEF and 60 ABD aircraft available and Sortie Rates set at 4.0)

Mission	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
BDEF	60	45	34	25	60
ABD	60	45	34	25	60

Chapter Summary

This chapter covered the model installation problems, data base construction problems, the results from each test case presented in Chapter Three, and other problem areas found.

The next chapter concludes with an overall impression of SOTACA's Air Module and ties the objectives from Chapter One with the results in Chapter Four.

Chapter Five
Conclusions and Recommendations

Overview

This chapter ties the results from Chapter Four with the objectives in Chapter One. In addition, comments from other reports bearing on SOTACA, but not specifically the Air Module, are mentioned. This is intended only as a source for additional research. Finally, recommendations for SOTACA's usefullness in combat studies is given.

Research Summary

The overall impression of SOTACA's Air Module (AM) is the concept of air used to write the AM is a valid concept with minor modifications; however, the implementation into computer code is in error. The air concept includes all the major air missions needed to model air in a theater level model, but the use and concept of fractional missions should be changed. The use of fractional missions (support aircraft such as the EF-111 Raven and the F-4 Wild Weasels) are not always tied to specfic air missions and when they are, the primary mission will go even if the support aircraft are unavailable.

The verification of the computer code showed the implementation of the air concept into a running model is not correct. The results in Chapter Four show examples of output that is

inconsistent from one output screen to another. In addition, output results from changes in fractional mission requirements and probabilities of Kill and Detection yield questionable results and in several cases, results that are incorrect.

Research Conclusions

The following conclusions relate to the reseach objectives:

Research Objective. The objective of this thesis was to verify the major functional areas of SOTACA's Air Module and to expand the explanation of the operation of this module. The overall verification was performed with the data base "Airtest" created for the Air Module's verification. The findings showed the Air Module modeled the nine air missions correctly, but the use of fractional missions and the attrition results are in error. The following is a summary of the sub-objectives and findings.

Sub-Objectives One. Sub-objective One ensures the nine air missions as stated in the analyst's guide are modeled correctly. This includes:

1. Close Air Support (CAS) attacks only forces in confrontation.

   Finding: CAS missions flew as stated in the air analysis guide (see Base Case-variation one).

2. Battlefield Air Interdiction (BAI) attacks forces within the BAI range that are not in confrontation.

   Finding: BAI missions flew and attacked forces within the BAI range not in confrontation(see Base Case-variation one).

3. Interdiction (IDR) attacks fixed target and forces outside of the BAI range.

Finding: IDR missions flew attacks against both fixed and force targets outside the BAI range (see Base Case-variation one).

4. Air Base Attack (ABA) attacks enemy airbases.

Finding: ABA attacked the Red Air base and casused the number of sorties during the next cycle to decrease(see Base Case-variation one).

5. Battlefield Defense (BDEF) intercepts and attrits offensive air missions in theater states 3, 5, 6, 8, 9 and 11.

Finding: BDEF intercepted and attrited offensive air missions; however they flew reguardless of whether the opposing air was flying and attrition results were questionable (see Base Case-variation one and Attrition Case-air-to-air attrition).

6. Air Base Defense (ABD) intercepts and attrits offensive air missions in theater state 6 and 8.

Finding: The ABD missions flew and intercepted the offensive air mission; however, attrition results were questionable (see Base Case-variation one and the Air-to-Air Attrition Case).

7. Escort, SAM, and GUN missions fly and have an effect on BDEF, ABD, and ADA forces resulting in less attrition of the primary missions. In addition, when these fractional missions are not available the primary missions do not fly.

Finding: The fractional missions all flew and caused a decrease in the losses of the primary missions they were supporting and when the fractional mission were not available the primary missions were aborted; however, not all available fractional missions flew causing primary missions to abort with assets available. In addition, in one case the primary missions flew without the required fractional mission support. (see Base Case-variation five and the Air-to-Air Attrition Case)

Sub-Objectives Two. Sub-objective two ensures the target lists for CAS, BAI, IDR, and ABA include all possible targets and are prioritized in the correct manner.

> Finding: All the target lists included the correct targets and were prioritized in the proper order (see Base Case-variation two)

Sub-Objectives Three. Ensure Air-to-Air, Air-to-Ground, and Ground-to-Air attrition works and appears to be reasonable.

> Finding: The attrition results were checked and the results were questionable. In one case, Red Air lost 42 aircraft but only flew 37. For the ground-to-air, no attrition occured even with Pds and Pks equal to 1.0 (see Ground-to-Air Attrition.

Additional Model Limitations

There are several reports to indicate other areas of SOTACA may be invalid and are mentioned here to give SOTACA users additional information that was found in researching the Air Module. These include the pairwise comparisions and the AMORE methodology.

The pairwise comparisons provide the user a great deal of flexibility but can be tedious and time consuming to perform. Two reports indicate that the work done in the pairwise comparison may have little meaning because the calibration phase converts the values obtained during these comparisons to a single attrition constant [21 and 9].

The AMORE (Analysis of Military Organization Effectiveness) methodology is a stochastic model use to determine a task force

effectiveness after a confrontation. In SOTACA, AMORE was modified into a deterministic model. A research thesis on the AMORE methodology from the Navel Postgraduate School concludes that AMORE is not accurate in its determination of a units effectiveness [11].

Finally, SOTACA's documentation is incomplete and outdated. The Analyst's Guide to Theory contains many errors and does not fully explain the air or the logistics modules.

Recommendations

The results from verifying SOTACA's Air Module indicates SOTACA is not reliable for studies involving air combat. In addition, other areas in the model may also be questionable. Prior to any use of SOTACA, the documentation and verification should be improved and the problems noted in this thesis corrected.

The reseach and verification effort for SOTACA's Air Module reveals problems common to all simulation models-documentation and a credible verification and validation program. It is far better to ensure these areas are throughly covered then to spend money paying contractors to add model improvements only to conclude the model is not valid or useful.

Appendix: Data Input Files for Airtest

This appendix includes all the input data for Airtest. All the following figures are excerpts from SOTACA, version 3.3 running at the Air Force Institute of Technology [1].

```
****************************** AREA SELECTION ********************************

     NO     NORTH AMERICA, GREENLAND
     NO     SOUTH AMERICA, CENTRAL AMERICA, MEXICO, ANTARTICA
     YES    EUROPE, ICELAND, NORDIC ISLANDS
     NO     ASIA, AUSTRALIA, POLYNESIA
     NO     AFRICA, MIDDLE EAST


***************** MAP TO CONTINGENCY AREA REGISTRATION ******************
  54 00 00 N    NORTHERN STANDARD PARALLEL (Available in mapsheet legend)
  50 00 00 N    SOUTHERN STANDARD PARALLEL (Available in mapsheet legend)

   3 00 00 E    WESTERNMOST LONGITUDE ON MAPSHEET
  12 00 00 E    EASTERNMOST LONGITUDE ON MAPSHEET

    192000 M    METERS FROM THE BOTTOM OF THE MAP SHEET TO    -  52 00 00 N
    264000 M    METERS FROM THE LEFT SIDE OF THE MAP SHEET TO -   7 30 00 E

  52 00 00 N    REFERENCE POINT LATITUDE ON MAPSHEET
   7 30 00 E    REFERENCE POINT LONGITUDE ON MAPSHEET

    192000 M    METERS FROM THE BOTTOM OF THE MAP SHEET TO    -  52 00 00 N
    264000 M    METERS FROM THE LEFT SIDE OF THE MAP SHEET TO -   7 30 00 E

  50 00 00 N    LOWER LEFT AREA LATITUDE OF INTEREST
   3 00 00 E    LOWER LEFT AREA LONGITUDE OF INTEREST

  54 00 00 N    UPPER RIGHT AREA LATITUDE OF INTEREST
  12 00 00 E    UPPER RIGHT AREA LONGITUDE OF INTEREST
```

Figure 5. Regional File Data Display

ID	--LOCATION-	NODE-TITLE / TYPE	--- NODE-DESCRIPTION ----	NODE_RDYNS
1	51 50 0 N		Blue Airbase	1.000
	9 28 0 E	>>> AIRBASE/AIRFLDS		

TO	--LOCATION-	NODE-TITLE / TYPE	LINK-TYPE	DISTANCE	--TIME-	CONDITION
2	51 50 0 N		ROAD	18.5	2.937	GOOD
	9 44 0 E	>>> BRIDGE				
6	51 40 0 N		ROAD	18.5	2.940	GOOD
	9 28 0 E	>>> BRIDGE				

ID	--LOCATION-	NODE-TITLE / TYPE	--- NODE-DESCRIPTION ----	NODE_RDYNS
2	51 50 0 N			1.000
	9 44 0 E	>>> BRIDGE		

TO	--LOCATION-	NODE-TITLE / TYPE	LINK-TYPE	DISTANCE	--TIME-	CONDITION
1	51 50 0 N		ROAD	18.5	2.937	GOOD
	9 28 0 E	>>> AIRBASE/AIRFLDS				
3	51 50 0 N		ROAD	18.5	2.937	GOOD
	10 0 0 E	>>> BRIDGE				
7	51 40 0 N		ROAD	18.5	2.940	GOOD
	9 44 0 E	>>> BRIDGE				

Figure 6. Network Data Display (Nodes 1 and 2)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
 3   51 50  0 N                                                      1.000
     10  0  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 2   51 50  0 N                       ROAD           18.5    2.937  GOOD
      9 44  0 E  >>> BRIDGE
 4   51 50  0 N                       ROAD           18.5    2.937  GOOD
     10 16  0 E  >>> BRIDGE
 8   51 40  0 N                       ROAD           18.5    2.940  GOOD
     10  0  0 E  >>> BRIDGE


ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
 4   51 50  0 N                                                      1.000
     10 16  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 3   51 50  0 N                       ROAD           18.5    2.937  GOOD
     10  0  0 E  >>> BRIDGE
 5   51 50  0 N                       ROAD           18.5    2.937  GOOD
     10 32  0 E  >>> CMD CNTRL SITE
 9   51 40  0 N                       ROAD           18.5    2.940  GOOD
     10 16  0 E  >>> BRIDGE
```

Figure 7. Network Data Display (Nodes 3 and 4)

```
ID   --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
 5    51 50  0 N                         Red Command Center             1.000
      10 32  0 E  >>> CMD CNTRL SITE

TO   --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 4    51 50  0 N                        ROAD           18.5    2.937  GOOD
      10 16  0 E  >>> BRIDGE
10    51 40  0 N                        ROAD           18.5    2.940  GOOD
      10 32  0 E  >>> BRIDGE


ID   --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
 6    51 40  0 N                                                     1.000
       9 28  0 E  >>> BRIDGE

TO   --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 1    51 50  0 N                        ROAD           18.5    2.940  GOOD
       9 28  0 E  >>> AIRBASE/AIRFLDS
 7    51 40  0 N                        ROAD           18.5    2.937  GOOD
       9 44  0 E  >>> BRIDGE
11    51 30  0 N                        ROAD           18.5    2.940  GOOD
       9 28  0 E  >>> BRIDGE
```

Figure 8. Network Data Display (Nodes 5 and 6)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
 7   51 40  0 N                                                        1.000
      9 44  0 E  >>> BRIDGE

 TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 2   51 50  0 N                        ROAD           18.5    2.940  GOOD
      9 44  0 E  >>> BRIDGE
 6   51 40  0 N                        ROAD           18.5    2.937  GOOD
      9 28  0 E  >>> BRIDGE
 8   51 40  0 N                        ROAD           18.5    2.937  GOOD
     10  0  0 E  >>> BRIDGE
12   51 30  0 N                        ROAD           18.5    2.940  GOOD
      9 44  0 E  >>> BRIDGE

ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
 8   51 40  0 N                                                        1.000
     10  0  0 E  >>> BRIDGE

 TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 3   51 50  0 N                        ROAD           18.5    2.940  GOOD
     10  0  0 E  >>> BRIDGE
 7   51 40  0 N                        ROAD           18.5    2.937  GOOD
      9 44  0 E  >>> BRIDGE
 9   51 40  0 N                        ROAD           18.5    2.937  GOOD
     10 16  0 E  >>> BRIDGE
13   51 30  0 N                        ROAD           18.5    2.940  GOOD
     10  0  0 E  >>> BRIDGE
```

Figure 9. Network Data Display (Nodes 7 and 8)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
 9   51 40  0 N                                                      1.000
     10 16  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 4   51 50  0 N                       ROAD           18.5    2.940  GOOD
     10 16  0 E  >>> BRIDGE
 8   51 40  0 N                       ROAD           18.5    2.937  GOOD
     10  0  0 E  >>> BRIDGE
10   51 40  0 N                       ROAD           18.5    2.937  GOOD
     10 32  0 E  >>> BRIDGE
14   51 30  0 N                       ROAD           18.5    2.940  GOOD
     10 16  0 E  >>> BRIDGE

ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
10   51 40  0 N                                                      1.000
     10 32  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 5   51 50  0 N                       ROAD           18.5    2.940  GOOD
     10 32  0 E  >>> CMD CNTRL SITE
 9   51 40  0 N                       ROAD           18.5    2.937  GOOD
     10 16  0 E  >>> BRIDGE
15   51 30  0 N                       ROAD           18.5    2.940  GOOD
     10 32  0 E  >>> BRIDGE
```

Figure 10. Network Data Display (Nodes 9 and 10)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
11    51 30  0 N                                                      1.000
       9 28  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 6    51 40  0 N                      ROAD           18.5    2.940  GOOD
       9 28  0 E  >>> BRIDGE
12    51 30  0 N                      ROAD           18.5    2.937  GOOD
       9 44  0 E  >>> BRIDGE
16    51 20  0 N                      ROAD           18.5    2.940  GOOD
       9 28  0 E  >>> BRIDGE
```



```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
12    51 30  0 N                                                      1.000
       9 44  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 7    51 40  0 N                      ROAD           18.5    2.940  GOOD
       9 44  0 E  >>> BRIDGE
11    51 30  0 N                      ROAD           18.5    2.937  GOOD
       9 28  0 E  >>> BRIDGE
13    51 30  0 N                      ROAD           18.5    2.937  GOOD
      10  0  0 E  >>> BRIDGE
17    51 20  0 N                      ROAD           18.5    2.940  GOOD
       9 44  0 E  >>> BRIDGE
```

Figure 11. Network Data Display (Nodes 11 and 12)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
13   51 30  0 N                                                        1.000
     10  0  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 8   51 40  0 N                       ROAD           18.5    2.940  GOOD
     10  0  0 E  >>> BRIDGE
12   51 30  0 N                       ROAD           18.5    2.937  GOOD
      9 44  0 E  >>> BRIDGE
14   51 30  0 N                       ROAD           18.5    2.937  GOOD
     10 16  0 E  >>> BRIDGE
18   51 20  0 N                       ROAD           18.5    2.940  GOOD
     10  0  0 E  >>> BRIDGE

ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
14   51 30  0 N                                                        1.000
     10 16  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 9   51 40  0 N                       ROAD           18.5    2.940  GOOD
     10 16  0 E  >>> BRIDGE
13   51 30  0 N                       ROAD           18.5    2.937  GOOD
     10  0  0 E  >>> BRIDGE
15   51 30  0 N                       ROAD           18.5    2.937  GOOD
     10 32  0 E  >>> BRIDGE
19   51 20  0 N                       ROAD           18.5    2.940  GOOD
     10 16  0 E  >>> BRIDGE
```

Figure 12. Network Data Display (Nodes 13 and 14)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
15   51 30  0 N                                                      1.000
     10 32  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
10   51 40  0 N                       ROAD           18.5    2.940  GOOD
     10 32  0 E  >>> BRIDGE
14   51 30  0 N                       ROAD           18.5    2.937  GOOD
     10 16  0 E  >>> BRIDGE
20   51 20  0 N                       ROAD           18.5    2.940  GOOD
     10 32  0 E  >>> BRIDGE
```



```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
16   51 20  0 N                                                      1.000
      9 28  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
11   51 30  0 N                       ROAD           18.5    2.940  GOOD
      9 28  0 E  >>> BRIDGE
17   51 20  0 N                       ROAD           18.6    2.952  GOOD
      9 44  0 E  >>> BRIDGE
21   51 10  0 N                       ROAD           18.5    2.940  GOOD
      9 28  0 E  >>> CMD CNTRL SITE
```

Figure 13. Network Data Display (Nodes 15 and 16)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
 17   51 20  0 N                                                      1.000
       9 44  0 E  >>> BRIDGE

 TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 12   51 30  0 N                       ROAD           18.5    2.940  GOOD
       9 44  0 E  >>> BRIDGE
 16   51 20  0 N                       ROAD           18.6    2.952  GOOD
       9 28  0 E  >>> BRIDGE
 18   51 20  0 N                       ROAD           18.6    2.952  GOOD
      10  0  0 E  >>> BRIDGE
 22   51 10  0 N                       ROAD           18.5    2.940  GOOD
       9 44  0 E  >>> BRIDGE
```



```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
 18   51 20  0 N                                                      1.000
      10  0  0 E  >>> BRIDGE

 TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 13   51 30  0 N                       ROAD           18.5    2.940  GOOD
      10  0  0 E  >>> BRIDGE
 17   51 20  0 N                       ROAD           18.6    2.952  GOOD
       9 44  0 E  >>> BRIDGE
 19   51 20  0 N                       ROAD           18.6    2.952  GOOD
      10 16  0 E  >>> BRIDGE
 23   51 10  0 N                       ROAD           18.5    2.940  GOOD
      10  0  0 E  >>> BRIDGE
```

Figure 14. Network Data Display (Nodes 17 and 18)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
 19   51 20  0 N                                                      1.000
      10 16  0 E  >>> BRIDGE

 TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 14   51 30  0 N                       ROAD           18.5    2.940  GOOD
      10 16  0 E  >>> BRIDGE
 18   51 20  0 N                       ROAD           18.6    2.952  GOOD
      10  0  0 E  >>> BRIDGE
 20   51 20  0 N                       ROAD           18.6    2.952  GOOD
      10 32  0 E  >>> BRIDGE
 24   51 10  0 N                       ROAD           18.5    2.940  GOOD
      10 16  0 E  >>> BRIDGE

ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
 20   51 20  0 N                                                      1.000
      10 32  0 E  >>> BRIDGE

 TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 15   51 30  0 N                       ROAD           18.5    2.940  GOOD
      10 32  0 E  >>> BRIDGE
 19   51 20  0 N                       ROAD           18.6    2.952  GOOD
      10 16  0 E  >>> BRIDGE
 25   51 10  0 N                       ROAD           18.5    2.940  GOOD
      10 32  0 E  >>> AIRBASE/AIRFLDS
```

Figure 15. Network Data Display (Nodes 19 and 20)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
21   51 10  0 N                         Blue Command Center            1.000
      9 28  0 E  >>> CMD CNTRL SITE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
16   51 20  0 N                        ROAD           18.5    2.940  GOOD
      9 28  0 E  >>> BRIDGE
22   51 10  0 N                        ROAD           18.6    2.952  GOOD
      9 44  0 E  >>> BRIDGE

ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
22   51 10  0 N                                                       1.000
      9 44  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
17   51 20  0 N                        ROAD           18.5    2.940  GOOD
      9 44  0 E  >>> BRIDGE
21   51 10  0 N                        ROAD           18.6    2.952  GOOD
      9 28  0 E  >>> CMD CNTRL SITE
23   51 10  0 N                        ROAD           18.6    2.952  GOOD
     10  0  0 E  >>> BRIDGE

ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----  NODE_RDYNS
23   51 10  0 N                                                       1.000
     10  0  0 E  >>> BRIDGE

TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
18   51 20  0 N                        ROAD           18.5    2.940  GOOD
     10  0  0 E  >>> BRIDGE
22   51 10  0 N                        ROAD           18.6    2.952  GOOD
      9 44  0 E  >>> BRIDGE
24   51 10  0 N                        ROAD           18.6    2.952  GOOD
     10 16  0 E  >>> BRIDGE
```

Figure 16. Network Data Display (Nodes 21, 22, and 23)

```
ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
 24   51 10  0 N                                                      1.000
      10 16  0 E  >>> BRIDGE

 TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 19   51 20  0 N                       ROAD           18.5    2.940  GOOD
      10 16  0 E  >>> BRIDGE
 23   51 10  0 N                       ROAD           18.6    2.952  GOOD
      10  0  0 E  >>> BRIDGE
 25   51 10  0 N                       ROAD           18.6    2.952  GOOD
      10 32  0 E  >>> AIRBASE/AIRFLDS


 ID  --LOCATION-  NODE-TITLE / TYPE      --- NODE-DESCRIPTION ----   NODE_RDYNS
 25   51 10  0 N                        Red Airbase                    1.000
      10 32  0 E  >>> AIRBASE/AIRFLDS

 TO  --LOCATION-  NODE-TITLE / TYPE     LINK-TYPE  DISTANCE  --TIME-  CONDITION
 20   51 20  0 N                       ROAD           18.5    2.940  GOOD
      10 32  0 E  >>> BRIDGE
 24   51 10  0 N                       ROAD           18.6    2.952  GOOD
      10 16  0 E  >>> BRIDGE
```

Figure 17. Network Data Display (Nodes 24 and 25)

L I N K S P E E D P A R A M E T E R S

---- SPEEDS(KM/HOUR) ----

LINK-TYPE	POOR	FAIR	GOOD
ROAD	25.0	37.5	6.3
AIR	100.0	200.0	400.0
RAIL	25.0	50.0	60.0
SEA	10.0	20.0	30.0
RIVER	15.0	25.0	35.0
LAKE	20.0	30.0	40.0
CROSS CTRY	3.5	7.5	12.5

Figure 18. Link Speed Parameters Data Display

AFF STRUCTURE BLUE (Available Forces File)	TYPE	QTY
MAJOR UNIT HEADINGS		
SUBORDINATE UNIT HEADINGS		
Blue Motorized Rifle Regiment		
Blue Headqtrs	1	1
Blue Rifle Bat	2	4
Blue Tank Bat	3	4
Blue How Bat	4	4
Blue Anti-air	5	4
Blue Air Wing		
F-15 ABD	101	1
F-15 Escort	102	1
F-16 BDEF	103	1
F-16 BAI	104	1
F-111A IDR	105	1
F-111D ABA	106	1
A-10 CAS	107	1
F-4 SAM/GUN	108	1
Blue Air Headquarters		
Headqtrs	6	1

AFF STRUCTURE RED (Available Forces File)	TYPE	QTY
MAJOR UNIT HEADINGS		
SUBORDINATE UNIT HEADINGS		
Red Motorized Rifle Regiment		
Red Headqtrs	500	1
Red Rifle Bat	501	4
Red Tank Bat	502	4
Red How Bat	503	4
Red Anti-air	504	4
Red Air Wing		
Red ABD	601	1
Red Escort	602	1
Red BDEF	603	1
Red BAI	604	1
Red IDR	605	1
Red ABA	606	1
Red CAS	607	1
Red SAM/GUN	608	1
Red Air Headquarters		
Headqtrs	505	1

Figure 19. Available Force Files

```
    U T D   (Unit Type Descriptor)                                  H = HELP
*****************************************************************************
  TYPE   1   BLUE                      Title: "Blue Headqtrs"

Basic Load POL                  100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                 100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies       100    Consumption Rate Other        1 (stons/day)
                                       Unit Shipping Weight          1 (stons)
                                       Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =   80     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   10     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    2     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    3     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =    0
Unit Size Designation             =    3
Personnel Substitutability %      =    0
Required for 100% Effectiveness
          -- Personnel            =    0
          -- Support Vehicles     =    0
```

Figure 20. Unit Type Descriptor 1

```
    U T D   (Unit Type Descriptor)                                  H = HELP
*************************************************************************
  TYPE   2   BLUE                    Title: "Blue Rifle Bat"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  500     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   70     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =   15     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =  150     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =  120     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =  120     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System                =    0
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 21. Unit Type Descriptor 2

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE   3   BLUE                    Title: "Blue Tank Bat"

Basic Load POL                100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo               100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies     100    Consumption Rate Other        1 (stons/day)
                                     Unit Shipping Weight          1 (stons)
                                     Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  200     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    6     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    2     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    2     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =   40     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =     0
Unit Size Designation             =     3
Personnel Substitutability %      =     0
Required for 100% Effectiveness
          -- Personnel            =     0
          -- Support Vehicles     =     0
```

Figure 22. Unit Type Descriptor 3

```
    U T D   (Unit Type Descriptor)                                   H = HELP
*************************************************************************
  TYPE   4   BLUE                      Title: "Blue How Bat"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  300     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   55     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    9     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =   40     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    2     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =    0
Unit Size Designation             =    3
Personnel Substitutability %      =    0
Required for 100% Effectiveness
          -- Personnel            =    0
          -- Support Vehicles     =    0
```

Figure 23. Unit Type Descriptor 4

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE   5   BLUE                    Title: "Blue Anti-air"

Basic Load POL                100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo               100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies     100    Consumption Rate Other        1 (stons/day)
                                     Unit Shipping Weight          1 (stons)
                                     Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =  10     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   10     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    3     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =   10     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    3     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =   30     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =     0
Unit Size Designation             =     3
Personnel Substitutability %      =     0
Required for 100% Effectiveness
          -- Personnel            =     0
          -- Support Vehicles     =     0
```

Figure 24. Unit Type Descriptor 5

```
    U T D   (Unit Type Descriptor)                                  H = HELP
*************************************************************************
  TYPE   6   BLUE                    Title: "Blue Air Headqt"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =  10     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    0     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =    0
Unit Size Designation             =    3
Personnel Substitutability %      =    0
Required for 100% Effectiveness
          -- Personnel            =    0
          -- Support Vehicles     =    0
```

Figure 25. Unit Type Descriptor 6

```
    U T D   (Unit Type Descriptor)                                  H = HELP
*************************************************************************
  TYPE 101   BLUE Air Unit          Title: "Blue Air Headqt"

Basic Load POL                100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo               100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies     100    Consumption Rate Other        1 (stons/day)
                                     Unit Shipping Weight          1 (stons)
                                     Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    0     16) ATK HELO 2  =    0     29) ATTACK 1   =    0
  4) AT1        =    0     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =    0     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =    0     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =   30     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System                =   23
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 26. Unit Type Descriptor 101

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 102   BLUE Air Unit          Title: "Blue F-15 Escor"

Basic Load POL                100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo               100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies     100    Consumption Rate Other        1 (stons/day)
                                     Unit Shipping Weight          1 (stons)
                                     Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR   =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1 =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    0     16) ATK HELO 2 =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3 =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1     =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2     =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3     =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4     =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5     =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1  =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2  =  30     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3  =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4  =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =    24
Unit Size Designation             =     3
Personnel Substitutability %      =     0
Required for 100% Effectiveness
          -- Personnel            =     0
          -- Support Vehicles     =     0
```

Figure 27. Unit Type Descriptor 102

```
    U T D    (Unit Type Descriptor)                                    H = HELP
*****************************************************************************
  TYPE 103    BLUE Air Unit            Title: "F-16 BDEF"

Basic Load POL                  100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                 100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies       100    Consumption Rate Other        1 (stons/day)
                                       Unit Shipping Weight          1 (stons)
                                       Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    0     16) ATK HELO 2  =    0     29) ATTACK 1   =    0
  4) AT1        =    0     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =    0     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =    0     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =    0     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =   30     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System              =    25
Unit Size Designation             =     3
Personnel Substitutability %      =     0
Required for 100% Effectiveness
          -- Personnel            =     0
          -- Support Vehicles     =     0
```

Figure 28. Unit Type Descriptor 103

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 104   BLUE Air Unit            Title: "Blue Air Headqt"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    0     16) ATK HELO 2  =    0     29) ATTACK 1   =    0
  4) AT1        =    0     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =    0     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =    0     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =    0     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   30     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System              =    26
Unit Size Designation             =     3
Personnel Substitutability %      =     0
Required for 100% Effectiveness
          -- Personnel            =     0
          -- Support Vehicles     =     0
```

Figure 29. Unit Type Descriptor 104

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 105   BLUE Air Unit            Title: "Blue Air Headqt"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR   =    0     27) FIGHTER 5  =  30
  2) SUPPRT VEH =   15     15) ATK HELO 1 =    0     28) FIGHTER 6  =   0
  3) PLATOONS   =    0     16) ATK HELO 2 =    0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3 =    0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1     =    0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2     =    0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3     =    0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4     =    0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5     =    0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1  =    0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2  =    0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3  =    0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4  =    0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =   27
Unit Size Designation             =    3
Personnel Substitutability %      =    0
Required for 100% Effectiveness
          -- Personnel            =    0
          -- Support Vehicles     =    0
```

Figure 30. Unit Type Descriptor 105

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 106   BLUE Air Unit            Title: "F-111  ABA"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =  30
  3) PLATOONS   =    0     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System                =   28
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 31. Unit Type Descriptor 106

```
    U T D   (Unit Type Descriptor)                                  H = HELP
*****************************************************************************
  TYPE 107   BLUE Air Unit            Title: "A-10 CAS"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    0     16) ATK HELO 2  =    0     29) ATTACK 1   =   30
  4) AT1        =    0     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =    0     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =    0     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =    0     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System                =   29
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 32. Unit Type Descriptor 107

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 108   BLUE Air Unit            Title: "F-4 SAM/GUN"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    0     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =  30
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System                =    30
Unit Size Designation               =     3
Personnel Substitutability %        =     0
Required for 100% Effectiveness
          -- Personnel              =     0
          -- Support Vehicles       =     0
```

Figure 33. Unit Type Descriptor 108

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE   1   RED                        Title: "Red Headqtrs"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =   80     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   10     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    2     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    3     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System                =    0
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 34. Unit Type Descriptor 500

```
    U T D   (Unit Type Descriptor)                                  H = HELP
*****************************************************************************
  TYPE 501   RED                      Title: "Red Rifle Bat`"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  500     14) AA RADAR    =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   70     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =   15     16) ATK HELO 2  =    0     29) ATTACK 1   =    0
  4) AT1        =  150     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =  120     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =  120     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =    0     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System                =     0
Unit Size Designation               =     3
Personnel Substitutability %        =     0
Required for 100% Effectiveness
          -- Personnel              =     0
          -- Support Vehicles       =     0
```

Figure 35. Unit Type Descriptor 501

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 502   RED                      Title: "Red Tank Bat"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  200     14) AA RADAR    =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    6     16) ATK HELO 2  =    0     29) ATTACK 1   =    0
  4) AT1        =    0     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =    2     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =    2     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =   40     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =    0     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System                =    0
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 36. Unit Type Descriptor 502

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 503   RED                        Title: "Red How Bat"

Basic Load POL                 100     Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100     Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100     Consumption Rate Other        1 (stons/day)
                                       Unit Shipping Weight          1 (stons)
                                       Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  300     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   55     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    9     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =   40     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    2     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =     0
Unit Size Designation             =     3
Personnel Substitutability %      =     0
Required for 100% Effectiveness
          -- Personnel            =     0
          -- Support Vehicles     =     0
```

Figure 37. Unit Type Descriptor 503

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 504   RED                      Title: "Red Anti-air"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =  10     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   10     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    3     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =   10     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    3     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =   30     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System                =     0
Unit Size Designation               =     3
Personnel Substitutability %        =     0
Required for 100% Effectiveness
          -- Personnel              =     0
          -- Support Vehicles       =     0
```

Figure 38. Unit Type Descriptor 504

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 505   RED                        Title: "Red Air Headqt"

Basic Load POL                 100     Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100     Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100     Consumption Rate Other        1 (stons/day)
                                       Unit Shipping Weight          1 (stons)
                                       Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =  10     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    0     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System                =    14
Unit Size Designation               =     3
Personnel Substitutability %        =     0
Required for 100% Effectiveness
            -- Personnel            =     0
            -- Support Vehicles     =     0
```

Figure 39. Unit Type Descriptor 505

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 601   RED  Air Unit            Title: "Red ABD"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR   =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   15     15) ATK HELO 1 =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    0     16) ATK HELO 2 =    0     29) ATTACK 1   =    0
  4) AT1        =    0     17) ATK HELO 3 =    0     30) ATTACK 2   =    0
  5) AT2        =    0     18) MISC 1     =    0     31) ATTACK 3   =    0
  6) APC        =    0     19) MISC 2     =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3     =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4     =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5     =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1  =   30     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2  =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3  =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4  =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System                =   23
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 40. Unit Type Descriptor 601

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 602   RED  Air Unit            Title: "Red Escort"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    0     16) ATK HELO 2  =    0     29) ATTACK 1   =    0
  4) AT1        =    0     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =    0     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =    0     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =    0     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   30     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System              =   24
Unit Size Designation             =    3
Personnel Substitutability %      =    0
Required for 100% Effectiveness
          -- Personnel            =    0
          -- Support Vehicles     =    0
```

Figure 41. Unit Type Descriptor 602

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 603   RED  Air Unit          Title: "Red BDEF"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    0     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =  30     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =    25
Unit Size Designation             =     3
Personnel Substitutability %      =     0
Required for 100% Effectiveness
          -- Personnel            =     0
          -- Support Vehicles     =     0
```

Figure 42. Unit Type Descriptor 603

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 604   RED  Air Unit          Title: "Red BAI"

Basic Load POL                 100   Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100   Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100   Consumption Rate Other        1 (stons/day)
                                     Unit Shipping Weight          1 (stons)
                                     Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    0     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =  30     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System              =    26
Unit Size Designation             =     3
Personnel Substitutability %      =     0
Required for 100% Effectiveness
          -- Personnel            =     0
          -- Support Vehicles     =     0
```

Figure 43. Unit Type Descriptor 604

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 605   RED  Air Unit            Title: "Red IDR"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =    0     27) FIGHTER 5  =   30
  2) SUPPRT VEH =   15     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    0     16) ATK HELO 2  =    0     29) ATTACK 1   =    0
  4) AT1        =    0     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =    0     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =    0     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =    0     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System              =   27
Unit Size Designation             =    3
Personnel Substitutability %      =    0
Required for 100% Effectiveness
          -- Personnel            =    0
          -- Support Vehicles     =    0
```

Figure 44. Unit Type Descriptor 605

```
   U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 606   RED  Air Unit            Title: "Red ABA"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =  30
  3) PLATOONS   =    0     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =   0
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System                =   28
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 45. Unit Type Descriptor 606

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 607   RED  Air Unit            Title: "Red CAS"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =    0     27) FIGHTER 5  =    0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =    0     28) FIGHTER 6  =    0
  3) PLATOONS   =    0     16) ATK HELO 2  =    0     29) ATTACK 1   =   30
  4) AT1        =    0     17) ATK HELO 3  =    0     30) ATTACK 2   =    0
  5) AT2        =    0     18) MISC 1      =    0     31) ATTACK 3   =    0
  6) APC        =    0     19) MISC 2      =    0     32) ATTACK 4   =    0
  7) IFV        =    0     20) MISC 3      =    0     33) ATTACK 5   =    0
  8) TANK1      =    0     21) MISC 4      =    0     34) ATTACK 6   =    0
  9) TANK2      =    0     22) MISC 5      =    0     35) AIR 1      =    0
 10) LACV       =    0     23) FIGHTER 1   =    0     36) AIR 2      =    0
 11) LT_ARTY    =    0     24) FIGHTER 2   =    0     37) AIR 3      =    0
 12) H_ARTY     =    0     25) FIGHTER 3   =    0     38) AIR 4      =    0
 13) AA OPTICAL =    0     26) FIGHTER 4   =    0     39) AIR 5      =    0

AMORE
*****
Pacing Weapon System                =   29
Unit Size Designation               =    3
Personnel Substitutability %        =    0
Required for 100% Effectiveness
          -- Personnel              =    0
          -- Support Vehicles       =    0
```

Figure 46. Unit Type Descriptor 607

```
    U T D   (Unit Type Descriptor)                                    H = HELP
*************************************************************************
  TYPE 608   RED  Air Unit            Title: "Red SAM/GUN"

Basic Load POL                 100    Consumption Rate POL          1 (gal/day)
Basic Load Ammo                100    Consumption Rate Ammo         1 (stons/day)
Basic Load Other Supplies      100    Consumption Rate Other        1 (stons/day)
                                      Unit Shipping Weight          1 (stons)
                                      Unit Shipping Volume          1 (cu. feet)

WEAPON TYPES
************
  1) PERSONNEL  =  100     14) AA RADAR    =   0     27) FIGHTER 5  =   0
  2) SUPPRT VEH =   15     15) ATK HELO 1  =   0     28) FIGHTER 6  =   0
  3) PLATOONS   =    0     16) ATK HELO 2  =   0     29) ATTACK 1   =   0
  4) AT1        =    0     17) ATK HELO 3  =   0     30) ATTACK 2   =  30
  5) AT2        =    0     18) MISC 1      =   0     31) ATTACK 3   =   0
  6) APC        =    0     19) MISC 2      =   0     32) ATTACK 4   =   0
  7) IFV        =    0     20) MISC 3      =   0     33) ATTACK 5   =   0
  8) TANK1      =    0     21) MISC 4      =   0     34) ATTACK 6   =   0
  9) TANK2      =    0     22) MISC 5      =   0     35) AIR 1      =   0
 10) LACV       =    0     23) FIGHTER 1   =   0     36) AIR 2      =   0
 11) LT_ARTY    =    0     24) FIGHTER 2   =   0     37) AIR 3      =   0
 12) H_ARTY     =    0     25) FIGHTER 3   =   0     38) AIR 4      =   0
 13) AA OPTICAL =    0     26) FIGHTER 4   =   0     39) AIR 5      =   0

AMORE
*****
Pacing Weapon System                =    30
Unit Size Designation               =     3
Personnel Substitutability %        =     0
Required for 100% Effectiveness
          -- Personnel              =     0
          -- Support Vehicles       =     0
```

Figure 47. Unit Type Descriptor 608

BLUE

F P F S T R U C T U R E (Forces Planning File) / MAJOR UNIT HEADINGS / SUBORDINATE UNIT HEADINGS	TYPE	QTY
Blue Motorized Rifle Regiment		
Blue Headqtrs	1	1
Blue Rifle Bat	2	4
Blue Tank Bat	3	4
Blue How Bat	4	4
Blue Anti-air	5	4
Blue Air Wing		
F-15 ABD	101	1
F-15 Escort	102	1
F-16 BDEF	103	1
F-16 BAI	104	1
F-111A IDR	105	1
F-111D ABA	106	1
A-10 CAS	107	1
F-4 SAM/GUN	108	1
Blue Air Headquarters		
Headqtrs	6	1

RED

F P F S T R U C T U R E (Forces Planning File) / MAJOR UNIT HEADINGS / SUBORDINATE UNIT HEADINGS	TYPE	QTY
Red Motorized Rifle Regiment		
Red Headqtrs	500	1
Red Rifle Bat	501	4
Red Tank Bat	502	4
Red How Bat	503	4
Red Anti-air	504	4
Blue Air Wing		
Red ABD	601	1
Red Escort	602	1
Red BDEF	603	1
Red BAI	604	1
Red IDR	605	1
Red ABA	606	1
Red CAS	607	1
Red SAM/GUN	608	1
Red Air Headquarters		
Headqtrs	505	1

Figure 48. Force Planning File

T F F S T R U C T U R E BLUE (Task Force File)	Q
Task Force Heading	T
UNIT Headings	Y
B Hqtrs	
Blue Headqtrs	1
Blue Rifle Bat	1
Blue Tank Bat	1
Blue How Bat	1
Blue Anti-air	1
B I	
Blue Rifle Bat	1
Blue Tank Bat	1
Blue How Bat	1
Blue Anti-air	1
B II	
Blue Rifle Bat	1
Blue Tank Bat	1
Blue How Bat	1
Blue Anti-air	1
B III	
Blue Rifle Bat	1
Blue Tank Bat	1
Blue How Bat	1
Blue Anti-air	1
B Air	
Headqtrs	1
F-15 ABD	1
F-15 Escort	1
F-16 BDEF	1
F-16 BAI	1
F-111A IDR	1
F-111D ABA	1
A-10 CAS	1
F-4 SAM/GUN	1

T F F S T R U C T U R E RED (Task Force File)	Q
Task Force Heading	T
UNIT Headings	Y
R Hqtrs	
Red Headqtrs	1
Red Rifle Bat	1
Red Tank Bat	1
Red How Bat	1
Red Anti-air	1
R I	
Red Rifle Bat	1
Red Tank Bat	1
Red How Bat	1
Red Anti-air	1
R II	
Red Rifle Bat	1
Red Tank Bat	1
Red How Bat	1
Red Anti-air	1
R III	
Red Rifle Bat	1
Red Tank Bat	1
Red How Bat	1
Red Anti-air	1
R Air	
Headqtrs	1
Red ABD	1
Red Escort	1
Red BDEF	1
Red BAI	1
Red IDR	1
Red ABA	1
Red CAS	1
Red SAM/GUN	1

Figure 49. Task Force File Data Display

BLUE Air Primary Mission Capabilities

	CAS	BAI	IDR	ABA	BDEF	ABD	ESCORT	SAM
F-15 ABD						1		
F-15 Escor							1	
F-16 BDEF					1			
F-16 BAI		1						
F-111A IDR			1					
F-111D ABA				1				
A-10 CAS	1							
F-4 SAM/GUN								1

Red Air Primary Mission Capabilities

	CAS	BAI	IDR	ABA	BDEF	ABD	ESCORT	SAM
Red ABD						1		
Red Escor							1	
Red BDEF					1			
Red BAI		1						
Red IDR			1					
Red ABA				1				
Red CAS	1							
Red SAM/GUN								1

Figure 50. Blue and Red Air Primary Mission Capabilities Data Display

BLUE	WEAPON TYPE	TOTAL FPF QUANTITY	CONFRONTER TITLE	A CONF-A DEF DESIGNATION
	PERSONNEL	5380	PERSONNEL	
	SUPPRT VEH	745	SUPPRT VEH	
	PLATOONS	134	PLATOONS	
	AT1	600	LT WEAPONS	
	AT2	688	HV WEAPONS	
	APC	511	APC	
	IFV	0		
	TANK1	160	TANK	
	TANK2	0		
	LACV	0		
	LT_ARTY	0		
	H_ARTY	0		
	AA OPTICAL	120	IR SAM	AD
	AA RADAR	50	RADAR SAM	AD
	ATK HELO 1	0		
	ATK HELO 2	0		
	ATK HELO 3	0		
	MISC 1	0		
	MISC 2	0		
	MISC 3	0		
	MISC 4	0		
	MISC 5	0		
	FIGHTER 1	30	F-15 ABD	AC
	FIGHTER 2	30	F-15 Escor	AC
	FIGHTER 3	30	F-16 BDEF	AC
	FIGHTER 4	30	F-16 BAI	AC
	FIGHTER 5	30	F-111A IDR	AC
	FIGHTER 6	30	F-111D ABA	AC
	ATTACK 1	30	A-10 CAS	AC
	ATTACK 2	30	F-4 SAM/GU	AC
	ATTACK 3	0		
	ATTACK 4	0		
	ATTACK 5	0		
	ATTACK 6	0		
	AIR 1	0		
	AIR 2	0		
	AIR 3	0		
	AIR 4	0		
	AIR 5	0		

Figure 51. Blue Confronter Definition File Data Display

RED	WEAPON TYPE	TOTAL FPF QUANTITY	CONFRONTER TITLE	A CONF-A DEF DESIGNATION
	PERSONNEL	5380	PERSONNEL	
	SUPPRT VEH	745	SUPPRT VEH	
	PLATOONS	134	PLATOONS	
	AT1	600	LT WEAPONS	
	AT2	688	HV WEAPONS	
	APC	511	APC	
	IFV	0		
	TANK1	160	TANK	
	TANK2	0		
	LACV	0		
	LT_ARTY	0		
	H_ARTY	0		
	AA OPTICAL	120	IR SAM	AD
	AA RADAR	50	RADAR SAM	AD
	ATK HELO 1	0		
	ATK HELO 2	0		
	ATK HELO 3	0		
	MISC 1	0		
	MISC 2	0		
	MISC 3	0		
	MISC 4	0		
	MISC 5	0		
	FIGHTER 1	30	RED ABD	AC
	FIGHTER 2	30	RED Escor	AC
	FIGHTER 3	30	RED BDEF	AC
	FIGHTER 4	30	RED BAI	AC
	FIGHTER 5	30	RED IDR	AC
	FIGHTER 6	30	RED ABA	AC
	ATTACK 1	30	RED CAS	AC
	ATTACK 2	30	RED SAM/GU	AC
	ATTACK 3	0		
	ATTACK 4	0		
	ATTACK 5	0		
	ATTACK 6	0		
	AIR 1	0		
	AIR 2	0		
	AIR 3	0		
	AIR 4	0		
	AIR 5	0		

Figure 52. Red Confronter Definition File Data Display

```
Confronter Definition File
==========================

CATEGORY TITLES FOR THE BLUE FORCE
----------------------------------
   Anti-Force


CATEGORY TITLES FOR THE BLUE FORCE
----------------------------------
   Anti-Force


MISSION MODE TITLES
-------------------
   Attack
```

Figure 53. Category Titles and Mission Modes

```
Confronter Definition File
==================================
*****RELATIVE CONFRONTER POWER BY CATEGORY FOR*****

BLUE MISSION MODE Attack

                          Anti-Force

   PERSONNEL              0.00000
   SUPPRT VEH             0.00000
   PLATOONS               0.20000
   LT WEAPONS             0.20000
   HV WEAPONS             0.20000
   APC                    0.20000
   TANK                   0.20000
   IR SAM                 0.00000
   RADAR SAM              0.00000
   F-15 ABD               0.00000
   F-15 Escor             0.00000
   F-16 BDEF              0.00000
   F-16 BAI               0.00000
   F-111A IDR             0.00000
   F-111D ABA             0.00000
   A-10 CAS               0.00000
   F-4 SAM/GU             0.00000


*****RELATIVE CONFRONTER POWER BY CATEGORY FOR*****

RED MISSION MODE Attack

                          Anti-Force

   PERSONNEL              0.00000
   SUPPRT VEH             0.00000
   PLATOONS               0.20000
   LT WEAPONS             0.20000
   HV WEAPONS             0.20000
   APC                    0.20000
   TANK                   0.20000
   IR SAM                 0.00000
   RADAR SAM              0.00000
   RED ABD                0.00000
   RED Escor              0.00000
   RED BDEF               0.00000
   RED BAI                0.00000
   RED IDR                0.00000
   RED ABA                0.00000
   RED CAS                0.00000
   RED SAM/GU             0.00000
```

Figure 54. Relative Confronter Power By Category

Confronter Definition File
==========

*****GENERAL VULNERABILITY BY CONFRONTER TO RED FORCE*****

BLUE MISSION MODE OF Attack

	VULNERABILITY
PERSONNEL	0.11111
SUPPRT VEH	0.11111
PLATOONS	0.11111
LT WEAPONS	0.11111
HV WEAPONS	0.11111
APC	0.11111
TANK	0.11111
IR SAM	0.11111
RADAR SAM	0.11111
F-15 ABD	0.00000
F-15 Escor	0.00000
F-16 BDEF	0.00000
F-16 BAI	0.00000
F-111A IDR	0.00000
F-111D ABA	0.00000
A-10 CAS	0.00000
F-4 SAM/GU	0.00000

*****GENERAL VULNERABILITY BY CONFRONTER TO BLUE FORCE*****

RED MISSION MODE OF Attack

	VULNERABILITY
PERSONNEL	0.11111
SUPPRT VEH	0.11111
PLATOONS	0.11111
LT WEAPONS	0.11111
HV WEAPONS	0.11111
APC	0.11111
TANK	0.11111
IR SAM	0.11111
RADAR SAM	0.11111
RED ABD	0.00000
RED Escor	0.00000
RED BDEF	0.00000
RED BAI	0.00000
RED IDR	0.00000
RED ABA	0.00000
RED CAS	0.00000
RED SAM/GU	0.00000

Figure 55. General Vulnerability

```
Confronter Definition File
==================================

*****RELATIVE VULNERABILITY TO RED CATEGORY FOR*****

BLUE MISSION MODE OF Attack

                        anti-force
   PERSONNEL              0.11111
   SUPPRT VEH             0.11111
   PLATOONS               0.11111
   LT WEAPONS             0.11111
   HV WEAPONS             0.11111
   APC                    0.11111
   TANK                   0.11111
   IR SAM                 0.11111
   RADAR SAM              0.11111
   F-15 ABD               0.00000
   F-15 Escor             0.00000
   F-16 BDEF              0.00000
   F-16 BAI               0.00000
   F-111A IDR             0.00000
   F-111D ABA             0.00000
   A-10 CAS               0.00000
   F-4 SAM/GU             0.00000


*****RELATIVE VULNERABILITY TO BLUE CATEGORY FOR*****

RED MISSION MODE OF Attack
                         anti-force
   PERSONNEL               0.11111
   SUPPRT VEH              0.11111
   PLATOONS                0.11111
   LT WEAPONS              0.11111
   HV WEAPONS              0.11111
   APC                     0.11111
   TANK                    0.11111
   IR SAM                  0.11111
   RADAR SAM               0.11111
   RED ABD                 0.00000
   RED Escor               0.00000
   RED BDEF                0.00000
   RED BAI                 0.00000
   RED IDR                 0.00000
   RED ABA                 0.00000
   RED CAS                 0.00000
   RED SAM/GU              0.00000
```

Figure 56. Relative Vulnerability by Confronter to Opposing Force Category

```
Force Planning File
=======================================

************* WEIGHTED CONFRONTATION SUMMARY ***************

BLUE MISSION = Attack                RED MISSION = Attack

WEIGHTED RED  TO BLUE FORCE RATIO =        1.00000

WEIGHTED BLUE TO RED  FORCE RATIO =        1.00000
```

Figure 57. Blue and Red Force Ratios

```
Decision Threshold File
=======================================

************** DECISION THRESHOLD ADJUSTMENTS ****************


BLUE-RED FORCE RATIO DECISION THRESHOLD ADJUSTMENTS
FOR CASE - Decision Threshold File

             MISSION TITLE           THRESHOLD

             Attack                    0.2000


RED-BLUE FORCE RATIO DECISION THRESHOLD ADJUSTMENTS
FOR CASE - Decision Threshold File

             MISSION TITLE           THRESHOLD

             Attack                    0.2000
```

Figure 58. Decision Thresholds for Mission Modes

Attitition Data

********** A T T R I T I O N R A T E S **********

SOTACA CYCLES USED FOR ADJUSTMENT = 1.00

BLUE MISSION MODE Attack -TO- RED MISSION MODE Attack

BLUE CONFRONTERS	INITIAL STRENGTH	6.0 HOUR SURVIVORS	ATTRITION MODE	6.0 HOUR SURV-RATE	EXPONENTIAL COEFFICIENT
PERSONNEL	5380	5380	E	1.0000	0.0000
SUPPRT VEH	745	745	E	1.0000	0.0000
PLATOONS	134	134	E	1.0000	0.0000
LT WEAPONS	600	600	E	1.0000	0.0000
HV WEAPONS	688	688	E	1.0000	0.0000
APC	511	511	E	1.0000	0.0000
TANK	160	160	E	1.0000	0.0000
IR SAM	120	120	E	1.0000	0.0000
RADAR SAM	50	50	E	1.0000	0.0000
F-15 ABD	30	30	E	1.0000	0.0000
F-15 Escor	30	30	E	1.0000	0.0000
F-16 BDEF	30	30	E	1.0000	0.0000
F-16 BAI	30	30	E	1.0000	0.0000
F-111A IDR	30	30	E	1.0000	0.0000
F-111D ABA	30	30	E	1.0000	0.0000
A-10 CAS	30	30	E	1.0000	0.0000
F-4 SAM/GU	30	30	E	1.0000	0.0000

Figure 59. Blue Attrition Data File

Attitition Data

SOTACA CYCLES USED FOR ADJUSTMENT = 1.00

RED MISSION MODE Attack -TO- BLUE MISSION MODE Attack

RED CONFRONTERS	INITIAL STRENGTH	6.0 HOUR SURVIVORS	ATTRITION MODE	6.0 HOUR SURV-RATE	EXPONENTIAL COEFFICIENT
PERSONNEL	5380	5380	E	1.0000	0.0000
SUPPRT VEH	745	745	E	1.0000	0.0000
PLATOONS	134	134	E	1.0000	0.0000
LT WEAPONS	600	600	E	1.0000	0.0000
HV WEAPONS	688	688	E	1.0000	0.0000
APC	511	511	E	1.0000	0.0000
TANK	160	160	E	1.0000	0.0000
IR SAM	120	120	E	1.0000	0.0000
RADAR SAM	50	50	E	1.0000	0.0000
RED ABD	30	30	E	1.0000	0.0000
RED Escort	30	30	E	1.0000	0.0000
RED BDEF	30	30	E	1.0000	0.0000
RED BAI	30	30	E	1.0000	0.0000
RED IDR	30	30	E	1.0000	0.0000
RED ABA	30	30	E	1.0000	0.0000
RED CAS	30	30	E	1.0000	0.0000
RED SAM/GU	30	30	E	1.0000	0.0000

Figure 60. Red Attrition Data File

```
BLUE    Air Mission Scheduling
                ************************
   AIR PLANNING CYCLE =    4 SOTACA cycles

   BAI     Range          =    30 km

   CAS     CYCLE          =  every  1, 2, 3, 4          cycle

   BAI     CYCLE          =  every  1, 2, 3, 4          cycle

   IDR     CYCLE          =  every  1, 2, 3, 4          cycle

   ABA     CYCLE          =  every  1, 2, 3, 4          cycle

   Each SOTACA cycle is   6 hours


RED     Air Mission Scheduling
                ************************
   AIR PLANNING CYCLE =    4 SOTACA cycles

   BAI     Range          =    30 km

   CAS     CYCLE          =  every  1, 2, 3, 4          cycle

   BAI     CYCLE          =  every  1, 2, 3, 4          cycle

   IDR     CYCLE          =  every  1, 2, 3, 4          cycle

   ABA     CYCLE          =  every  1, 2, 3, 4          cycle

   Each SOTACA cycle is   6 hours
```

Figure 61. Air Mission Scheduling Data Display

BLUE Air Apportionment Order

Mission	Priority	Apportionment (%)
CAS	1	12
BAI	2	12
IDR	3	12
ABA	4	12
BDEF	5	12
ABD	6	12
ESCORT	7	14
SAM	8	14
Notuse	9	0

RED Air Apportionment Order

Mission	Priority	Apportionment (%)
CAS	1	12
BAI	2	12
IDR	3	12
ABA	4	12
BDEF	5	12
ABD	6	12
ESCORT	7	14
SAM	8	14
Notuse	9	0

Figure 62. Blue and Red Air Apportionment Order Data Display

BLUE Air Fractional Mission Requirements

	ESCORT	SAM	Notuse
CAS	0.10	0.10	
BAI	0.10	0.10	
IDR	0.10	0.10	
ABA	0.10	0.10	

Red Air Fractional Mission Requirements

	ESCORT	SAM	Notuse
CAS	0.01	0.01	
BAI	0.01	0.01	
IDR	0.01	0.01	
ABA	0.01	0.01	

Figure 63. Blue and Red Fractional Mission Requirements

CAS Task Force Priority
Support LOWEST Force Ratio

BLUE TASK FORCE	TARGET PRIORITY	RED TASK FORCE	TARGET PRIORITY
B III	Y	R III	Y
B II	Y	R II	Y
B I	Y	R I	Y
B Hqtrs	Y	R Hqtrs	Y
B Air	Y	R Air	Y

Figure 64. CAS Target Priorities for Blue and Red Air

BAI Task Force Priority

BLUE TASK FORCE	TARGET PRIORITY	RED TASK FORCE	TARGET PRIORITY
B III	Y	R III	Y
B II	Y	R II	Y
B I	Y	R I	Y
B Hqtrs	Y	R Hqtrs	Y
B Air	Y	R Air	Y

Figure 65. BAI Target Priorities for Blue and Red Air

Preplanned IDR Target Priority

BLUE		RED	
TASK FORCES	1	TASK FORCES	1
CMD CNTRL SITE	3	CMD CNTRL SITE	3
SUPPLY POINTS		SUPPLY POINTS	
KEY TERRAIN		KEY TERRAIN	
URBAN AREA (Lg)		URBAN AREA (Lg)	
URBAN AREA (Sm)		URBAN AREA (Sm)	
PORT AREA		PORT AREA	
BEACHHEAD		BEACHHEAD	
BRIDGE	2	BRIDGE	2
RAILHEAD		RAILHEAD	
WAR RESERVE		WAR RESERVE	

IDR Task Force Priority

BLUE TASK FORCE	TARGET PRIORITY	RED TASK FORCE	TARGET PRIORITY
B III	Y	R III	Y
B II	Y	R II	Y
B I	Y	R I	Y
B Hqtrs	Y	R Hqtrs	Y
B Air	Y	R Air	Y

Figure 66. IDR Target Priorities for Blue and Red Air

TARGET LIST LIMITS

	BLUE	RED
CAS	N	N
BAI	N	N
IDR	N	N
ABA	N	N

Figure 67. Blue and Red Target List Limits

BLUE Air Defense Data

Area Air Defense Belt - Width: 20.0 km
Depth: 20.0 km

Average Range of HIMAD Systems: 20.00 km

RED Air Defense Data

Area Air Defense Belt - Width: 20.0 km
Depth: 20.0 km

Average Range of HIMAD Systems: 20.00 km

Figure 68. Air Defense Belt Data Display

BLUE Theater State Adjustment Factors

	Adjustment Factor	
	Ingress	Egress
FRIENDLY AIR SPACE	1.00	-
FORWARD GRD AD	1.00	1.00
FORWARD AIR AD	1.00	1.00
GRD AD	1.00	1.00
AIR AD	1.00	1.00
TARGET AIR AD	1.00	1.00
TARGET GRD POINT DEF	1.00	-

RED Theater State Adjustment Factors

	Adjustment Factor	
	Ingress	Egress
FRIENDLY AIR SPACE	1.00	-
FORWARD GRD AD	1.00	1.00
FORWARD AIR AD	1.00	1.00
GRD AD	1.00	1.00
AIR AD	1.00	1.00
TARGET AIR AD	1.00	1.00
TARGET GRD POINT DEF	1.00	-

Figure 69. Blue and Red Theater State Adjustment Factors

Air PRIMARY Mission Types

CAS
BAI
IDR
ABA
BDEF
ABD

Air FRACTIONAL Mission Types

ESCORT
SAM
Notuse

Figure 70. Air Mission Titles

Theater State Titles

BLUE	RED
FRIENDLY AIR SPACE	FRIENDLY AIR SPACE
FORWARD GRD AD	FORWARD ADA
FORWARD AIR AD	FORWARD AREA DEFENSE
GRD AD	AREA DEFENSE
AIR AD	AIRBASE DEFENSE
TARGET AIR AD	TARGET AREA DEFENSE
TARGET GRD POINT DEF	TARGET

Figure 71. Theater State Titles

MUNITION LOAD TITLES

BLUE	RED
Bombs	Bombs
Missiles	Missiles
[EOF]	[EOF]

Figure 72. Munition Load Titles

BLUE FIXED TARGET MUNITION LOADS

TARGET TYPE	PRIMARY MISSION	MUNITION LOADS	SORTIES REQUIRED	EFFECTS / DEGRADATION
AIRBASE/AIRFLDS	ABA	Bombs	10	0.250
CMD CNTRL SITE	IDR	Bombs	10	0.250
SUPPLY POINTS	IDR			
KEY TERRAIN	IDR			
URBAN AREA (Lg)	IDR			
URBAN AREA (Sm)	IDR			
PORT AREA	IDR			
BEACHHEAD	IDR			
BRIDGE	IDR	Bombs	10	0.250
RAILHEAD	IDR			
WAR RESERVE	IDR			

RED FIXED TARGET MUNITION LOADS

TARGET TYPE	PRIMARY MISSION	MUNITION LOADS	SORTIES REQUIRED	EFFECTS / DEGRADATION
AIRBASE/AIRFLDS	ABA	Bombs	10	0.250
CMD CNTRL SITE	IDR	Bombs	10	0.250
SUPPLY POINTS	IDR			
KEY TERRAIN	IDR			
URBAN AREA (Lg)	IDR			
URBAN AREA (Sm)	IDR			
PORT AREA	IDR			
BEACHHEAD	IDR			
BRIDGE	IDR	Bombs	10	0.250
RAILHEAD	IDR			
WAR RESERVE	IDR			

Figure 73. Fixed Target Munition Loads/Effects for Both Blue and Red Air

BLUE Targeting
RED Force Size Definition

FORCE SIZE TITLE	FORCE POWER
All	< 1
	350

Target Forces		
Highest Power:	R Hqtrs	105.40
Average Power:	All Task Forces	83.72
Lowest Power:	R Air	0.00

RED Targeting
BLUE Force Size Definition

FORCE SIZE TITLE	FORCE POWER
All	< 1
	350

Target Forces		
Highest Power:	B Hqtrs	105.40
Average Power:	All Task Forces	83.72
Lowest Power:	B Air	0.00

Figure 74. Force Target Size Definition

BLUE FORCE TARGET MUNITION LOADS

FORCE SIZE	PRIMARY MISSION	MUNITION LOADS	SORTIES REQUIRED	EFFECTS / DEGRADATION
All	CAS	Bombs	10	0.250
	BAI	Bombs	10	0.250
	IDR	Bombs	10	0.250

RED FORCE TARGET MUNITION LOADS

FORCE SIZE	PRIMARY MISSION	MUNITION LOADS	SORTIES REQUIRED	EFFECTS / DEGRADATION
All	CAS	Bombs	10	0.250
	BAI	Bombs	10	0.250
	IDR	Bombs	10	0.250

Figure 75. Force Target Munition Loads/Effects

BLUE FIXED/FORCE TARGET ADJUSTMENT FACTORS

Fixed Target Adjustment Factor	0.000
Force Target Adjustment Factor	0.000

RED FIXED/FORCE TARGET ADJUSTMENT FACTORS

Fixed Target Adjustment Factor	0.000
Force Target Adjustment Factor	0.000

Figure 76. Fixed/Force Target Adjustment Factors

BLUE AIRCRAFT OPERATING CAPABILITIES

AIRCRAFT TYPE	OPERATING RANGE(km)	EFFECTIVE RANGE	AVERAGE SPEED(km/hr)
F-15 ABD	1000	0.90	480
F-15 Escor	1000	0.90	480
F-16 BDEF	1000	0.90	480
F-16 BAI	1000	0.90	480
F-111A IDR	1000	0.90	480
F-111D ABA	1000	0.90	480
A-10 CAS	1000	0.90	480
F-4 SAM/GU	1000	0.90	480

RED AIRCRAFT OPERATING CAPABILITIES

AIRCRAFT TYPE	OPERATING RANGE(km)	EFFECTIVE RANGE	AVERAGE SPEED(km/hr)
RED ABD	1000	0.90	480
RED Escort	1000	0.90	480
RED BDEF	1000	0.90	480
RED BAI	1000	0.90	480
RED IDR	1000	0.90	480
RED ABA	1000	0.90	480
RED CAS	1000	0.90	480
RED SAM/GU	1000	0.90	480

Figure 77. Aircraft Operating Capabilities

BLUE SORTIE PLANNING RATES

AIRCRAFT TYPE	MISSION CAS	BAI	IDR	ABA	BDEF	ABD	ESCORT	SAM	Notuse
F-15 ABD						6.0			
F-15 Escor							6.0		
F-16 BDEF					6.0				
F-16 BAI		6.0							
F-111A IDR			6.0						
F-111D ABA				6.0					
A-10 CAS	6.0								
F-4 SAM/GU								6.0	

RED SORTIE PLANNING RATES

AIRCRAFT TYPE	MISSION CAS	BAI	IDR	ABA	BDEF	ABD	ESCORT	SAM	Notuse
RED ABD						6.0			
RED Escort							6.0		
RED BDEF					6.0				
RED BAI		6.0							
RED IDR			6.0						
RED ABA				6.0					
RED CAS	6.0								
RED SAM/GU								6.0	

Figure 78. Sortie Planning Rates

BLUE AIRCRAFT MUNITION LOADS

AIRCRAFT TYPE	MUNITION LOADS
F-15 ABD	Bombs
F-15 Escor	Missiles
F-16 BDEF	Missiles
F-16 BAI	Bombs
F-111A IDR	Bombs
F-111D ABA	Bombs
A-10 CAS	Bombs
F-4 SAM/GU	Bombs

POSSIBLE MUNITION LOADS
1 Bombs
2 Missiles

BLUE AIRCRAFT MUNITION LOADS

AIRCRAFT TYPE	MUNITION LOADS
RED ABD	Bombs
RED Escort	Missiles
RED BDEF	Missiles
RED BAI	Bombs
RED IDR	Bombs
RED ABA	Bombs
RED CAS	Bombs
RED SAM/GU	Bombs

POSSIBLE MUNITION LOADS
1 Bombs
2 Missiles

Figure 79. Possible Aircraft Munition Loads

BLUE NONCOMBAT (THEATER STATE 1) ATTRITION FACTORS

CONFRONTER	ATTRITION
F-15 ABD	0.000
F-15 Escor	0.000
F-16 BDEF	0.000
F-16 BAI	0.000
F-111A IDR	0.000
F-111D ABA	0.000
A-10 CAS	0.000
F-4 SAM/GU	0.000

RED NONCOMBAT (THEATER STATE 1) ATTRITION FACTORS

CONFRONTER	ATTRITION
RED ABD	0.000
RED Escor	0.000
RED BDEF	0.000
RED BAI	0.000
RED IDR	0.000
RED ABA	0.000
RED CAS	0.000
RED SAM/GU	0.000

Figure 80. Theater State One Attrition Factors

BLUE PROBABILITY OF KILL
AIR-TO-AIR

SHOOTER/ TARGET	RED ABD	RED ESCORT	RED BDEF	RED BAI	RED IDR	RED ABA	RED CAS	RED SAM/GU
F-15 ABD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-15 Escor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-16 BDEF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-16 BAI	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-111A IDR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-111D ABA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A-10 CAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-4 SAM/GU	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

RED PROBABILITY OF KILL
AIR-TO-AIR

SHOOTER/ TARGET	F-15 ABD	F-15 Escor	F-16 BDEF	F-16 BAI	F-111A IDR	F-111D ABA	A-10 CAS	F-4 SAM/GU
RED ABD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED Escort	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED BDEF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED BAI	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED IDR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED ABA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED CAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED SAM/GU	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 81. Blue and Red Air-to-Air Probabilities of Kill

BLUE PROBABILITY OF DETECTION
AIR-TO-AIR

SHOOTER/ TARGET	RED ABD	RED ESCORT	RED BDEF	RED BAI	RED IDR	RED ABA	RED CAS	RED SAM/GU
F-15 ABD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-15 Escor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-16 BDEF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-16 BAI	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-111A IDR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-111D ABA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A-10 CAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-4 SAM/GU	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

RED PROBABILITY OF DETECTION
AIR-TO-AIR

SHOOTER/ TARGET	F-15 ABD	F-15 Escor	F-16 BDEF	F-16 BAI	F-111A IDR	F-111D ABA	A-10 CAS	F-4 SAM/GU
RED ABD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED Escort	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED BDEF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED BAI	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED IDR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED ABA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED CAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RED SAM/GU	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 82. Blue and Red Air-to-Air Probabilities of Detection

BLUE PROBABILITY OF KILL
AIR-TO-GROUND

SHOOTER/ TARGET	IR SAM	RADAR SAM
F-15 ABD	0.000	0.000
F-15 Escor	0.000	0.000
F-16 BDEF	0.000	0.000
F-16 BAI	0.000	0.000
F-111A IDR	0.000	0.000
F-111D ABA	0.000	0.000
A-10 CAS	0.000	0.000
F-4 SAM/GU	0.000	0.000

RED PROBABILITY OF KILL
AIR-TO-GROUND

SHOOTER/ TARGET	IR SAM	RADAR SAM
RED ABD	0.000	0.000
RED Escort	0.000	0.000
RED BDEF	0.000	0.000
RED BAI	0.000	0.000
RED IDR	0.000	0.000
RED ABA	0.000	0.000
RED CAS	0.000	0.000
RED SAM/GU	0.000	0.000

Figure 83. Blue and Red Air-to-Ground Probabilities of Kill

BLUE PROBABILITY OF DETECTION
AIR-TO-GROUND

SHOOTER/ TARGET	IR SAM	RADAR SAM
F-15 ABD	0.000	0.000
F-15 Escor	0.000	0.000
F-16 BDEF	0.000	0.000
F-16 BAI	0.000	0.000
F-111A IDR	0.000	0.000
F-111D ABA	0.000	0.000
A-10 CAS	0.000	0.000
F-4 SAM/GU	0.000	0.000

RED PROBABILITY OF DETECTION
AIR-TO-GROUND

SHOOTER/ TARGET	IR SAM	RADAR SAM
RED ABD	0.000	0.000
RED Escort	0.000	0.000
RED BDEF	0.000	0.000
RED BAI	0.000	0.000
RED IDR	0.000	0.000
RED ABA	0.000	0.000
RED CAS	0.000	0.000
RED SAM/GU	0.000	0.000

Figure 84. Blue and Red Air-to-Ground Probabilities of Detection

BLUE PROBABILITY OF KILL
GROUND-TO-AIR

SHOOTER/ TARGET	RED ABD	RED ESCORT	RED BDEF	RED BAI	RED IDR	RED ABA	RED CAS	RED SAM/GU
IR SAM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RADAR SAM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

RED PROBABILITY OF KILL
GROUND-TO-AIR

SHOOTER/ TARGET	F-15 ABD	F-15 Escor	F-16 BDEF	F-16 BAI	F-111A IDR	F-111D ABA	A-10 CAS	F-4 SAM/GU
IR SAM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RADAR SAM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 85. Blue and Red Ground-to-Air Probabilities of Kill

BLUE PROBABILITY OF DETECTION
GROUND-TO-AIR

SHOOTER/ TARGET	RED ABD	RED ESCORT	RED BDEF	RED BAI	RED IDR	RED ABA	RED CAS	RED SAM/GU
IR SAM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RADAR SAM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

RED PROBABILITY OF DETECTION
GROUND-TO-AIR

SHOOTER/ TARGET	F-15 ABD	F-15 Escor	F-16 BDEF	F-16 BAI	F-111A IDR	F-111D ABA	A-10 CAS	F-4 SAM/GU
IR SAM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RADAR SAM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Figure 86. Blue and Red Ground-to-Air Probabilities of Detection

BLUE AIR

TYPICAL EMPLOYMENT CONFRONTER	NUMBER
F-15 ABD	2
F-15 Escor	2
F-16 BDEF	2
F-16 BAI	2
F-111A IDR	2
F-111D ABA	2
A-10 CAS	2
F-4 SAM/GU	2

RED AIR

TYPICAL EMPOLYMENT CONFRONTER	NUMBER
RED ABD	2
RED Escort	2
RED BDEF	2
RED BAI	2
RED IDR	2
RED ABA	2
RED CAS	2
RED SAM/GU	2

Figure 87. Typical Employment for Blue and Red Air

BLUE GROUND

TYPICAL EMPLOYMENT CONFRONTER	NUMBER
IR SAM	2
RADAR SAM	2

RED GROUND

TYPICAL EMPOLYMENT CONFRONTER	NUMBER
IR SAM	2
RADAR SAM	2

Figure 88. Typical Employment for Blue and Red Ground

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All computer simulation models require verification and validation if the studies conducted using these models are to have any credibility; however, in an effort to get a model up and running, or study completed, the verification and validation process is delayed and may never get done. The State of the Art Contingency Anaylst (SOTACA) Model is a good example. This paper introduces the general issue of model verification and validation and explains the current efforts done in this area on SOTACA. In addition, a methodology for verifing SOTACA's Air Module and the findings from this verification is given.

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Background information on SOTACA is given to include general operation of the model, the operation and purpose of SOTACA's Air Module, and the comments and results from previous tests and reports conducted by SOTACA's users. These reports show very little previous testing has been done on SOTACA's Air Module.

The methodology used, was to build a data base, scenario, and test cases to test specific functional areas of the Air Module. The findings give problems encountered while installing, preparing the data base, and running the model. The findings indicate many of the functional areas of the Air Module have problems and the overall impression of the Air Module, is it is not reliable for studies involving air combat. In addition, other areas in the model may also be questionable. Prior to any use of SOTACA, the documentation and verification should be improved.

The research and verification effort for SOTACA's Air Module reveals problems common to all simulation models-documentation and a credible verification and validation program. The primary recommendation from this research effort is to recommend all future models are well documented and verified for without this, the studies conducted with these models will not be credible.